FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 89 Thursday, July 13, 1950 No. 1767

49, Wellington Street, London, W.C.2.

Grams: "Zacatecas, Rand, London"

'Phone: Temple Bar 3951 (Private Branch Exchange)

PUBLISHED WEEKLY: 26s. per annum (Home and Overseas)

B.C.I.R.A. Open Day

Last week, with due ceremony, Mr. P. H. Wilson, O.B.E., the president, opened the extensions to the laboratories of British Cast Iron Research Association at Alvechurch. The new building comprises a machine- and mechanical-testing laboratory, together with a spacious staff dining room and kitchen. Advantage of the occasion was taken for members to inspect the whole of the establishment, and it is interesting to note that there were many who were there for the first time. This is a direct result of the alteration of the conditions of membership since the Association received additional funds derived from the pig-iron levy. Many of the visitors appeared to us to be the young metallurgists associated with the ironfoundry industry. Though the time available for inspection was limited, we hoped they realised that they possessed at Alvechurch a practical and theoretical service specially designed to help them to give to their employers the fullest support to current production problems. There is no doubt that some of them would like to ask, "How can I change over from being little more than a routine chemist into a foundry metallurgist?" Such a question is capable of being answered providing the fullest information is given as to staff, nature and quantity of output and services already given, and whether the man feels that he is prepared to take full responsibility for added activities. We refer to this angle because of the recent creation of the operational research team, who will require for the implementation of their suggestions the fullest co-operation of the staff the firms visited, alike in the fields of practical work and metallurgical control.

We are sure that the visitors, like ourselves, received from this visit an impression of a happy team anxious, not to blind the visitors with science, but to learn from them and thereby to ensure a foundation of mutual help for the greatest benefit of the industry. The days of epoch-making discovery are limited, but an era of straight-line progress has been opened out, provided the barriers of prejudice can be broken down and replaced by the fullest co-operation. We may be wrong in suggesting "prejudice," and we believe that it is some form of shyness on the part of foundry executives which prevents a maximum of help being sought.

We, like most founders, are inveterate gossips, and because of this we missed much that we intended to inspect, but, realising that the Association invariably welcomes visitors, we, in common with all other founders, can return and learn much more of the work being done and the sometimes exceptional services being given. We hope that many of our readers will take this broad hint.

Metals in the Service of Mankind

The exhibition of Metals in the Service of Mankind at the Science Museum, South Kensington, London, was opened last Thursday by Princess Margaret. It has been organised by the Institution of Metallurgists in co-operation with many other bodies. Before dealing with this specialised exhibition it is as well to visualise its surroundings and their impact on the visitor. The adjacent hall houses exhibits of early locomotives, motor-cars, and cycles. They are necessarily of dull colours and contrast vividly with the bright, modern—not futuristic—atmosphere of the metallurgical exhibi-

Contents

	Page
B.C.I.R.A. Open Day	29
Metals in the Service of Mankind	29
Schoolboys see Moulding Demonstration	30
Visitors from Australia	30
Sand-cast Test-bars for Copper-base Alloys	31
Ring Tests	36
Large Aluminium-alloy Pulley	36
Loam and Dry-sand Moulding in the Jobbing Foundry	37
Clyde Shipbuilding	43
British Non-ferrous Metals Federation	44
Metal Crucibles for Melting Aluminium Alloys	45
Neophyte Architects Design a Foundry	48
B.I.S.R.A. Appointments	49
Carbon Monoxide Detection	49
A.S.T.M. Awards	50
Gas Escape at Consett Ironworks	50
Manganese Ore Dearer	50
Pig-iron and Steel Production in Great Britain	52
Raw Materials Markets	54
Fourth World Power Conference	54

tion. The next factor is that a very high percentage of the visitors are school children and students from the adjacent colleges. Catering for this class of visitor is not easy, but most of the exhibits have succeeded. Dates, especially for those entering from the hall referred to, are important. This has been realised in the layout of the space illustrating the potentialities of nickel. Most of the metals have their own sections, but the allocation has been higgledy-piggledy.

The first exhibit, chronologically, is primitive smelting, whilst adjoining is one devoted to aluminium. However, for the modest expenditure of a shilling one can buy a guide book, which is in truth an excellent elementary text-book on metallurgy. There is one bad mistake, however: the annual output of iron castings is given as 1½ instead of 3½ million tons. As is to be expected, the iron and steel exhibit is of striking character, and makes excellent use of the science of lighting. The cast-iron section, organised by the British Cast Iron Research Association, displays on one side a series of excellent castings with coloured ribbons directing attention to the properties they have to fulfil. Again using more ribbons, the eye is taken to the corresponding microstructures. Anybody even casually glancing at the exhibit must be impressed with the fact that cast iron is a wide range of alloys —each having its own characteristic. On the opposite side there is a simple casting for a cooker shown in four stages from when it leaves the mould complete with runners and risers to a smart vitreous-enamelled component ready for use. In between, there is a section through a large mould designed to emphasise the craftsmanship necessary for the production of a big casting. This is a type of service to the foundry industry which is often passed unnoticed by the average ironfounder, yet for the future of the industry it is very important.

Many of the other metals, especially aluminium, are shown in the form of castings. We were sorry that the exhibit of tin and its products did not include the well-known tin of tripe as used in the Crimean war. We are sure this would have interested and impressed the younger visitors. Unfortunately, metallurgy does not lend itself to much "knob-pressing," but we are convinced that there is shown material which will fascinate both old and young. As the exhibition remains open until September, a visit by all who are located in London or come on holiday must be included. Moreover, if it is possible to include the children, so much the better.

THE MINISTRY OF SUPPLY has announced that the selling price of Turkish chrome, basis 43 per cent., scale 5s., has been reduced to £13 9s. 5d. per ton ex ship and £14 7s. 6d. per ton ex store, delivered f.o.r. nearest point consumers' works.

Schoolboys see Moulding Demonstration

At the special invitation of Mr. W. R. F. Smart, headmaster of Townfield School, Hayes, Middlesex, Mr. W. Wilson and Mr. A. Talbot of Western Foundries, on Monday of this week presented a programme designed to interest boys in the foundry industry as a career. About 160 boys from schools in the Hayes area attended, mainly senior students who will shortly be leaving school. Mr. Wilson gave an introductory talk on the history of founding, stressing the fact that founding is an art which has developed through generations of craftsmen—craftsmen whose services are still in demand to-day. Two films were then shown, "Casting in Iron," and "Moulding with a Loose Pattern"; the latter is an American film for the training of apprentices.

The films were followed by an actual moulding demonstration given by Mr. Talbot. Each stage in the process of moulding and pouring a small bogie-wheel casting was followed with great interest. In addition, Mr. Talbot operated his model cupola, by means of which charging, melting and tapping could be demonstrated. The programme ended by Mr. Wilson and Mr. Talbot answering the boys' questions regarding foundry work. In this discussion a number of boys expressed a definite desire to enter the foundry industry. Copies of the Council of Ironfoundry Associations' booklet "Choosing your Career" were given to those who wanted further information.

Another factor worthy of note is that the handicraft masters at Townfield School are including an outline of foundry work in their curriculum. In this they have the co-operation of the two foundrymen, who are to be complimented on their enthusiasm in tackling the foundry recruitment problem.

Visitors from Australia

Mr. E. J. Tippett, director of Ronaldson-Tippett, of Ballarat, left Australia on May 23 for the U.S.A., U.K., Germany and Switzerland to finalise agreements for the Australian production of stationary air-cooled petrol and kerosene engines and to study foundry practice. His London address is c/o Bank of Australasia, Threadneedle Street, E.C.

Mr. I. Arnold, of Vacu-Blast (Aust.) Pty., Limited, Mitcham, Victoria, left Australia on June 23 for the U.S.A. and U.K. to study the performance of blast-cleaning machines and the latest methods for their servicing and repair. His London address is c/o Mr. Robert R. Wilson, 95, Gresham Street, E.C.2.

Mr. T. N. Mitchell, managing director of Mitchell & Company Proprietary, Limited, West Footscray, Victoria, left Australia for the U.S.A., U.K., and the Continent on June 28 to discuss with principals the methods of manufacture and business activities generally and possible production of agricultural implements in Australia. His address is c/o Union Bank of Australia, Limited, London, W.1.

Mr. P. L. Martyn, managing director, and J. S. Robertson, director of the Steel Company of Australia Proprietary, Limited, Coburg, left in the Orion, on July 12, for the U.K., Europe, India, and South Africa, to investigate the production of water turbines, steam, Diesel and electric locomotives and large turbo-generators and to finalise matters relating to patent rights. The London address will be c/o Vulcan Foundry, Limited, 82, Victoria Street, S.W.1.

Sand-cast Test-bars for Copper-base Alloys*

By O. R. J. Lee,† Ph.D., M.Sc., and B. W. Peck, B.Met.‡

The British Standards Institution has recently recommended a wedge-type test-bar for general adoption by the copper-alloy sand-founding industry. The present Paper describes work carried out to determine the mechanical properties obtainable from these test-pieces when prepared from high-quality melts of the following copper-base alloys:—88/8/4 gunmetal, 83/7/5/5 leaded gunmetal, 89.65/10/0.35 phosphor bronze and 90/10 aluminium bronze. The results found with the wedge bar are compared with those obtained from D.T.D.*-type bars. It is concluded that the wedge bar is capable of giving results above the specification limits in all the alloys studied provided degassed metal is employed. With phosphor-bronze and high-phosphorus gunmetal, gas absorption from the mould (metal-mould reaction) may cause the properties of the wedge bar to fall below the specification limits, but this can be avoided by the use of a low pouring temperature. In general, the* D.T.D. *bar appears more sensitive than the wedge bar to changes in metal quality and is, therefore, to be preferred for foundry control purposes.*

IN THE "Code of Procedure in the Inspection of Copper-base Alloy Castings" issued by the British Standards Institution, a recommendation is made for the forms of separately-cast test-bars to be used. A wedge-type block is considered suitable for all types of sand-cast copper alloys and is specified as the standard test-bar. The code recognises that difficulty may be experienced by some foundries in meeting existing specification requirements with this type of bar in gunmetals of the 88/10/2 and 86/7/5/2 types, and for phosphor-bronze. It allows, therefore, the "I.B.F." type of shaped bar as an alternative for these alloys.

The work upon which these recommendations were based is described in a Paper by F. Hudson.[1] Bars made by all the foundries co-operating in these tests passed the strength requirements of the British Standards for aluminium-bronze, manganese-brass and 85/5/5/5 gunmetal using the proposed B.S.I. wedge block. However, only 50 per cent. of the foundries passed the requirements for 88/10/2 and phosphor-bronze (B.S. 421) when using the wedge block. With the alternative I.B.F.-shaped bar, all foundries were able to exceed the requirements for 88/10/2, but only half of them were able to pass the phosphor-bronze requirements. Hudson concludes:—"There is every reason to believe that the form of keel bar recommended will ultimately prove satisfactory for all copper-base alloys when foundrymen become more familiar with its use, and for the purpose of standardisation the adoption of one design of test-bar is a distinct advantage."

In his Paper, Hudson considers that dissolved gas in the metal might have contributed considerably to the low results obtained on certain of the bronzes. It was felt that a series of tests on degassed melts and melts with controlled gas contents using melting methods developed by the B.N.F.M.R.A.[2,3] would be a useful supplement to the data given by Hudson and that a comparison of the B.S.I. wedge block with the D.T.D. type hitherto used in the B.N.F.M.R.A. laboratories should be made, to assess their relative merits as test-bars for foundry control purposes.

Experimental Details

Melts of 60 to 70 lb. of alloys made from virgin metal charges of usual commercial purity (plus scrap arising from the experiments) were prepared in salamander crucibles in a gas-fired injector furnace. Eight test-bars were poured from each melt, the B.S.I. and D.T.D. types being poured alternately. Most of the tests were in dried Mansfield sand moulds, but one melt of each alloy was poured into green-sand moulds having 5 per cent. moisture content. Table I gives the compositions and treatments of the alloys used. Except for aluminium-bronze, which is not prone to gas absorption, precautions were taken to reduce the gas contents of the melts to a minimum, so that the test-bars would show the maximum mechanical properties likely to be attained with the various alloys in the two forms of test-bar employed.

Previous B.N.F.M.R.A. work[3,4] has shown that bronzes containing phosphorus react with the steam generated in sand moulds (even in "dry-sand" moulds) and absorb some of the liberated hydrogen during solidification in the mould. In such alloys (MPB, MSF, Table I) "degassed" melts will therefore show gas porosity in the final castings. This gas porosity may be distributed more uniformly than shrinkage porosity, when the latter is otherwise present, with consequent benefit to the properties of the castings, and it is recommended[3] that for castings which are not fully fed, some gas absorption should be promoted by suitably adjusting the phosphorus content. It is important that test-bars for controlling this process should reveal the gas absorption by decreases in strength, and this object will be achieved if the bars are well fed and do not cool too quickly.

---

* This Paper, a communication from the British Non-ferrous Metals Research Association, was presented at the Annual Conference of the Institute of British Foundrymen. The work described in this Paper was made available to members of the B.N.F.M.R.A. in a confidential report issued in 1947.

† Formerly head of melting and casting section, B.N.F.M.R.A., London.

‡ Research metallurgist, Magnesium Elektron, Limited, Clifton, Manchester; formerly research bursar, B.N.F.M.R.A., London.

TABLE I.—*Alloys Investigated.*

Mark.	Cu, per cent.	Sn, per cent.	Zn, per cent.	Pb, per cent.	Al, per cent.	P, per cent.	Method of degassing.
MPA	88	8	4	—	—	0.020	Manganese ore
MPB	89.7	10	—	—	—	0.35	N_2 stream
MPC	83	7	5	5	—	0.020	Manganese ore
MPD	90	—	—	—	10	—	Rapid melting
MSF	88	8	4	—	—	0.070/0.091	Manganese ore

The amount of gas porosity resulting from the presence of 0.08 to 0.10 per cent. phosphorus in an 88/8/4 alloy is likely to equal or exceed the maximum amounts required in practice for imperfectly-fed castings, and this amount of gas porosity lowers the strength of the D.T.D. type of bar to just above the specification limit (16 tons per sq. in.). The proposed B.S.I. bar will cool more slowly than the D.T.D. bar because of its larger mass, and might therefore be expected to absorb more gas with a given phosphorus content and pouring temperature. Accordingly, in addition to the phosphor-bronze, in which considerable gas is absorbed by mould reaction, four melts of 88/8/4 gunmetal (MSF, Table I) were made with phosphorus contents of 0.07 to 0.09 per cent. to compare the two types of test-bar in alloys of moderate gas content.

It may be emphasised at this point that the effect on the casting of gas absorbed by the metal from mould reaction is more beneficial than that of gas remaining in the metal from pick-up during melting. Quite apart from the aspect of ease of control, if it is desired to have gas present in a casting, it is therefore strongly recommended that melts should be adequately degassed and then regassed in the mould by means of controlled phosphorus additions, since gas absorbed in the mould has a more beneficial effect than gas picked up in melting.

TABLE II.—*Comparison of Results from B.S.I. Wedge Bars and D.T.D. Bars.*

Casting temp., deg. C.	Type of sand.	Type of bar	No. of tests.	Per cent. voids, average (range)	U.T.S., tons per sq. in. average (range).	Elongation per cent., average (range).	0.1 per cent. P.S., tons per sq. in.
Degassed 88/8/4 *Gunmetal* (0.02 *per cent. P*)							
1,180	green	Wedge	4	2.6 (2.4–2.8)	17.5 (17.0–18.3)	34 (31–37)	7.3
		DTD	3	1.4 (1.4–1.4)	18.6 (17.1–20.6)	38 (30–54)	7.6
1,180	dry	Wedge	3	2.5 (2.1–2.7)	18.9 (18.4–19.7)	43 (42–44)	7.2
		DTD	4	1.6 (1.5–1.7)	20.9 (20.1–21.7)	54 (39–65)	7.3
1,140	dry	Wedge	4	1.7 (1.6–2.0)	19.7 (19.5–20.3)	44 (44–45)	7.5
		DTD	4	1.0 (0.9–1.2)	20.5 (19.9–21.1)	48 (40–56)	7.6
1,100	dry	Wedge	4	1.3 (1.0–1.8)	20.1 (18.9–20.8)	38 (30–41)	8.0
		DTD	4	0.8 (0.8–1.0)	21.7 (20.9–22.1)	42 (40–46)	8.4
1,060	dry	Wedge	4	0.9 (0.7–1.3)	20.6 (19.5–21.2)	37 (30–42)	8.1
		DTD	4	0.7 (0.6–0.9)	22.6 (22.4–23.1)	45 (44–47)	8.6
Degassed 83/7/5/5 *Gunmetal* (0.02 *per cent. P*)							
1,180	green	Wedge	4	2.1 (1.8–2.4)	15.7 (15.4–16.2)	33 (29–35)	6.2
		DTD	3	1.3 (0.8–2.4)	17.1 (15.9–17.9)	29 (19–34)	6.7
1,180	dry	Wedge	3	1.4 (1.4–1.4)	16.0 (15.5–16.5)	34 (30–37)	6.7
		DTD	4	0.5 (0.5–0.5)	17.5 (17.3–18.0)	36 (33–39)	7.1
1,140	dry	Wedge	4	1.3 (0.9–1.5)	16.7 (15.0–18.0)	36 (29–40)	6.6
		DTD	4	0.7 (0.7–0.7)	17.6 (17.0–18.4)	35 (28–40)	6.9
1,100	dry	Wedge	4	0.7 (0.1–1.5)	16.6 (15.8–17.4)	34 (30–39)	6.9
		DTD	4	0.5 (0.5–0.6)	17.2 (16.8–17.8)	29 (26–34)	7.0
1,060	dry	Wedge	3	1.4 (0.9–1.7)	17.6 (17.2–17.9)	25 (21–30)	7.8
		DTD	4	1.0 (0.8–1.3)	16.2 (14.0–17.6)	18 (13–21)	7.9
1,130	green	Wedge	2	3.1 (3.0–3.2)	15.2 (15·1–15.3)	31 (31–31)	—
No phosphorus added.		DTD	2	1.3 (1.3–1.4)	18.2 (17.6–18.8)	37 (35–39)	—
Aluminium Bronze (90 *per cent. Cu*, 10 *per cent. Al*)							
1,180 (10.4 per cent. Al)	dry	Wedge	4	0.2 (0.1–0.5)	24.5 (24.2–25.4)	28 (19–36)	6.7
1,140 (9.5 per cent Al)	dry	Wedge	4	0.2 (0.2–0.2)	27.7 (27.2–28.0)	42 (39–45)	6.8
1,100 (10.2 per cent. Al)	dry	Wedge	4	0.2 (0.2–0.3)	26.7 (25.4–27.4)	27 (16–30)	7.0
1,060 (10.5 per cent. Al)	dry	Wedge	4	0.1 (0.1–0.1)	27.7 (27.2–28.2)	23 (18–26)	7.4
88/8/4 *Gunmetal with gas absorbed from the mould* (0.07–0.09 *per cent. P*)							
1,180 (0.084 per cent. P)	green	Wedge	4	3·8 (3·4–4.0)	14.6 (14.0–15.6)	19 (15–21)	—
		DTD	4	3.4 (2.2–4.5)	15.4 (10.9–19.6)	18 (10–27)	—
1,180 (0.091 per cent. P)	dry	Wedge	4	2.9 (2.8–3.0)	15.9 (14.4–17.2)	28 (24–30)	6.5
		DTD	4	2.0 (1.8–2.4)	17.4 (16.4–19.8)	29 (23–43)	7.0
1,180 (0.07 per cent. P)	dry	Wedge	4	2.5 (2.1–2.9)	16.8 (15.5–17.3)	25 (22–30)	7.0
		DTD	4	2.2 (1.6–2.6)	17.4 (15.4–19.2)	19 (15–30)	7.3
1,080 (0.084 per cent. P)	dry	Wedge	4	2.5 (2.3–2.8)	17.9 (17.0–18.9)	35 (29–40)	—
		DTD	4	2.2 (2.0–2.6)	18.4 (18.2–18.8)	32 (30–35)	—
10 *per cent. Sn phosphor bronze with gas absorbed from the mould* (0.31–0.35 *per cent. P*)							
1,140	green	Wedge	4	2.4 (2.3–2.6)	16.5 (16.1–17.4)	20 (16–23)	7.5
		DTD	4	1.8 (1.0–2.4)	20.3 (18.8–21.5)	25 (21–34)	8.8
1,140	dry	Wedge	4	2.1 (1.9–2.2)	17.1 (17.0–17.2)	24 (23–25)	7.3
		DTD	4	1.1 (0.8–1.4)	18.9 (17.6–21.6)	26 (19–33)	7.9
1,100	dry	Wedge	4	0.2 (0.1–0.5)	21.1 (20.7–21.8)	39 (33–45)	8.4
		DTD	4	0.1 (0.1–0.3)	23.9 (23.2–24.6)	44 (36–51)	9.1
1,060	dry	Wedge	4	1.1 (0.6–2.2)	22.4 (22.0–22.8)	30 (25–35)	9.4
		DTD	4	0.4 (0.2–0.7)	23.8 (21.0–24.8)	41 (25–51)	9.9

Results of Tests

The test results are presented in Table II.

88/8/4 *Gunmetal* (*gas free*).

Table II shows the results obtained at casting temperatures of 1,060 to 1,180 deg. C. in dry-sand moulds, and at 1,180 deg. C. in green-sand moulds. Both types of bar had high densities and tensile properties well above the specification limits. The D.T.D. type was slightly superior to all casting temperatures, the average difference being 0.1 per cent. proof stress, 0.5 tons per sq. in., U.T.S. 1.5 tons per sq. in., and elongation 6 per cent.

The percentage voids given in Table II indicate that the wedge bar gives satisfactory feeding with alloys of short freezing range (*i.e.*, aluminium-bronze), but gunmetals with wide freezing ranges do not feed so well in this test-bar as in the D.T.D.-type bar. The wedge bars have about 1½ times the amount of porosity found in the D.T.D. bars. This is considered to be due to the fairly flat temperature gradients coupled with the larger grain size resulting from the slower cooling. When cast at 1,180 deg. C. in green sand, the wedge bars had average grain diameters of 3.9 to 4.1 mm., whereas the D.T.D. bars had had 3.4 to 3.5 mm. average grain diameter. In dry-sand moulds cast at 1,060 deg. C., the corresponding figures were 0.6 and 0.1 mm. for wedge and D.T.D. bars respectively. The apparent effect of grain size is supported by current work on grain refinement where it has been found that material with a grain size of the order of 0.1 mm. gives wedge and D.T.D. test-bars of equally high density (cast at 1,180 deg. C.).

83/7/5/5 *Leaded Gunmetal* (*gas free*).

Table II shows the results for casting temperatures of 1,060 to 1,180 deg. C. Behaviour similar to that of the 88/8/4 alloy was obtained, but the superiority of the D.T.D. bar was less marked with the leaded alloy. A specification strength of 14 tons per sq. in. could easily be met by the wedge bar on the basis of the values obtained in these tests. The slight inferiority of the wedge bar is again a reflection of the lower density values. With this alloy, tests were made to find out whether this lower density was caused by slight mould reaction due to the slower rate of cooling of the wedge block. Bars were cast without any phosphorus additions and the wedge bar was even more inferior to the D.T.D. bar in respect of density. This behaviour is therefore not caused by mould reaction effects due to phosphorus.

88/8/4 *Gunmetal with moderate gas content.*

Glaisher[4] has described the use of phosphorus additions for introducing small quantities of gas into castings which are not fully fed, thus causing an improved distribution of the shrinkage porosity and a consequent improvement in the mechanical properties and pressure tightness of certain parts of the casting. In fully-fed castings and in the otherwise sound parts of imperfectly-fed castings, the gas absorption naturally impairs the mechanical properties and this effect can be utilised as a check to confirm that the phosphorus content of the metal, the pouring temperature and the condition of the sand are such that the required amount of gas absorption occurs. The maximum amount of gas absorption likely to be deliberately produced by this means, lowers the strength of D.T.D.-type test-bars nearly to the specification minimum. If, with a new type of test-bar, the strength values fell below the specification limit, inconvenience would result because good castings might be condemned on the evidence of the test bar. Comparison of the results in Table II for gas-free metal with those for 88/8/4 gunmetal containing up to 0.09 per cent. phosphorus shows that the wedge bar is more likely to fall below the specification limit than the D.T.D. bar when the phosphorus content is over 0.07 per cent. In the limiting cases, however, the specification values can be met by the wedge bar if the casting temperature is lowered, and this remedy is a satisfactory one because it still gives test-bar results which reflect changes in the gas content of the metal.

There is evidence that small amounts of gas introduced by mould reaction cause less reduction in the strength of the wedge block than in the D.T.D. bar. This may be because the former contains more shrinkage porosity when cast in gas-free bronze or gunmetal and is therefore almost in the class of incompletely fed castings which can be improved by slight mould reaction. This view is consistent with the fact that where slight gas absorption occurred, the effect of gas was to reduce the density of both types of bar, but the D.T.D. type suffered most reduction.

When larger quantities of gas absorption are involved, the wedge-type bar is much more affected than the D.T.D. type, because of its slower rate of cooling; so that in the most gassy melt produced in this series (0.084 per cent. P in green sand), the average D.T.D. bar density was 0.081 gm. per cc. higher than the wedge bar and the strength was 2.5 tons per sq. in. greater.

Phosphor Bronze (10 *per cent. Sn.* 0.35 *per cent. P*).

As would be anticipated from the previous results, the wedge bars in this alloy were less dense than the D.T.D. type, particularly at the high casting temperatures, as shown in Table II. When cast into green-sand moulds from 1,140 deg. C., the wedge-type bar gave results reasonably well above the Admiralty requirement of 15 tons per sq. in. for gear wheels of the composition used. Reduction in casting temperature to a more normal level of 1,100 deg. C. increased the strength of wedge bars cast in dry-sand moulds to just over 21 tons/per sq. in. The 0.1 per cent. proof stress was about 0.5 tons per sq. in. longer for the wedge type bar than for D.T.D. bars, and the corresponding difference in U.T.S. values was about 2 tons per sq. in.

Aluminium Bronze (90 *per cent. Cu*, 10 *per cent. Al*).

A type of test-bar very similar to the wedge block has been in use for many years with aluminium-bronzes and high-tensile brasses. There was thus no doubt than the B.S.I. test-bar proposals would be generally acceptable for these types of alloy. Some tests on aluminium-bronze were included in the present work mainly with the object of investigating possible troubles due to trapped oxide skins when top pouring was employed. Such troubles

were only encountered with a pouring temperature of 1,180 deg. C.

Conclusions

(1) The proposed B.S.I. wedge bar will pass existing specifications for gunmetals if the metal is completely degassed, although the strengths will not be quite as high as with the D.T.D.-type bar.

(2) For alloys which absorb gas from sand moulds, such as phosphor-bronzes and gunmetals of relatively high phosphorus content, both types of test-bar show reductions in strength which reveal the gas absorption, but the wedge bar is less sound than the D.T.D. type and small amounts of gas are detected with more certainty in the latter bar. With larger amounts of gas there is little to choose between the two bars as a guide to gas content, but the properties of the wedge bar are more likely to fall below the specification limit. This inconvenience can be avoided by lowering the pouring temperature for the test-bar, without sacrificing any sensitivity to gas content.

Thus both the wedge bar and the D.T.D. bar are capable of passing present specification minima and are suitable for inspection purposes for the various tin bronzes. They are also sufficiently sensitive to variations in foundry procedure to be suitable for exercising control over metal condition, although the D.T.D. type appears preferable from both points of view.

(3) Top pouring methods for wedge bars are capable of giving good results on copper-base alloys containing aluminium, providing the casting temperature is not too high.

Acknowledgments

The Authors' thanks are due to the director and council of the British Non-ferrous Metals Research Association for permission to publish this Paper.

REFERENCES

1 F. Hudson, *Proc. Inst. Brit. Foundrymen*, 1945/6, **79**, A72.
2 W. A. Baker and F. C. Child, . *Inst. Metals*, 1944, **70**, 349.
3 W. A. Baker, F. C. Child and W. H. Glaisher. *J. Inst. Metals*, 1944, **70**, 373.
4 W. H. Glaisher. B.N.F.M.R.A. work (awaiting publication).

(*Mr. Peck presented the Paper at the* I.B.F. *conference, his co-author, Dr. Lee, being in Australia.*)

DISCUSSION

Replying to MR. T. H. WEAVER, MR. PECK said that the test-bars (reported in Table II) were cast in dry-sand moulds and, in an answer to MR. G. R. NORWOOD, that they were all sand cast.

MR. NORWOOD asked whether the D.T.D. bars were poured at the top and cast vertically, and whether cleaner castings and better results might have been obtained by tilting.

MR. PECK replied that they were poured at the top and in some cases were tilted.

The CHAIRMAN commented that the wedge-type bar was still only a proposal.

MR. PECK agreed, and said the I.B.F. bar was still permitted by specification.

A MEMBER asked whether the results obtained were reproducible for a particular set of conditions, and whether the density gave a direct guide to soundness in the alloys discussed. In the light alloys, he said, there seemed to be a relationship between density and soundness, even better than was given by (say) a macrosection, but in the case of ferrous metals some work with which he had been associated had not shown any direct or consistent relationship between density and soundness or the degree of unsoundness.

MR. PECK said that the reproducibility of the results was good and that there was a marked correlation between the density measurements and soundness. The MEMBER then asked whether similar work had been attempted on actual castings or portions of castings, from the point of view of measuring density as a means of assessing unsoundness.

MR. PECK replied that no such work had been done before he left the British Non-ferrous Metals Research Association two years ago.

MR. Z. STOKOWIEC asked what type of test-bar Mr. Peck would suggest for high-tensile aluminium bronze to specification B.S.412.

MR. PECK suggested the wedge bar. He and his colleagues had no confidence in the D.T.D. bar for aluminium bronze.

MR. G. R. NORWOOD suggested that, when casting in chills, the D.T.D. bar would give the best results, and that it was only because the Authors had used sand moulds that they had found the wedge bar to have advantages; there was such a bulk of metal in the wedge bar that one could not obtain the chilling effect as in the D.T.D. bar. Comparative experiments would be interesting.

MR. PECK replied that the D.T.D. bar gave better properties than the wedge bar with most alloys, for the reason Mr. Norwood had stated.

Design of Test-bars

MR. A. R. MARTIN, referring to test-bar shape, said that, although his experience was concerned with aluminium alloys and not copper-base alloys, he considered that his remarks would apply to any alloy system and to any alloy within a system. A test-bar is required to give an indication of the properties of a material as affected by metallurgical conditions and not casting conditions. If the material were in the best condition metallurgically, the only other factor which would influence the result was the way in which the alloy solidified. Those alloys freezing over a very narrow temperature range would give the least trouble.

The best test-bar design for any and all alloys should surely be one in which solidification commenced in the region where one needed to measure the properties (*i.e.*, the gauge length of the test-piece) and proceeded outwards towards the test-bar grips. This condition was only obtained in a horizontally cast shaped test-piece gated at both ends. He was therefore interested to note that the I.B.F. cast-to-shape test-piece had merely been mentioned in the Paper and, although the results had apparently been satisfactory, it had not been included in the work carried out by the B.N.F.M.R.A.

MR. PECK said that with most alloys the I.B.F. bar did not give a good indication of metal quality.

MR. MARTIN emphasised that the cast-to-shape test-piece gave a true indication of the properties of a material as affected by its metallurgical condition, and if the material had not been treated correctly, inferior results would be obtained. The qualification of the shaped test-piece was that the result was less affected by casting conditions than was the case with any other design.

MR. PECK agreed that if the metal were cast under the best possible conditions, and in particular if the metal were gas-free, one would obtain a much better idea of what high-quality metal was capable of doing. However, the purpose of a test-bar was to indicate whether the metal was of high quality and had been properly prepared; a shaped bar was unsatisfactory from this point of view, for it often gave good results with metal of mediocre quality.

The CHAIRMAN (Mr. Colin Gresty) said the question seemed to be whether one wanted the best results from a test-bar or the most representative check on the metal. He would like the point followed up; it had not yet been made quite clear just why there were three different forms of bar.

Bars for Rapid Testing

MR. W. G. MOCHRIE first thanked the Authors for having made public their contribution towards solving the problem of the results obtainable from bars recommended by the B.S.I. There existed a bar which was said to be representative of the metal in the casting, but it appeared that there was also another bar in the offing which gave an indication of the quality of the metal in the melt. If one kept those facts in mind, it would help to clarify opinion on the matter. He wanted a test-specimen which would give an indication of melt quality, as compared with something which the inspector would machine at a later date. He had in mind a test-bar to indicate gas content, for example.

MR. T. H. WEAVER said it seemed that such a bar would give some indication of what could be arrived at under certain specific conditions. He was, however, concerned as to whether the results of a test-bar of metal taken from the furnace in the middle of the melt would indicate the results to be obtained from a casting weighing 2 or 5 cwts. He felt that it would not be generally accepted by qualified inspectors.

MR. MOCHRIE urged that one should be able, for internal foundry purposes, to take a sample of metal from the furnace and make a quick test, and determine therefrom, with a certain degree of accuracy, whether the metal was right or wrong before casting. Excess gas could be detected from the solidifying D.T.D.-type bar in copper, copper-nickel and nickel silver, but he wondered whether a fracture test-piece designed to accentuate evidence of irregularities in the melt could be adopted for the complete range of non-ferrous alloys.

MR. E. JACKSON noted that the Authors had stopped at a tin content of 10 per cent., and he asked whether either of the bars were in use for the higher-tin, higher-phosphorus metals. His experience was that neither of them gave the best results with the higher-tin bronzes.

MR. B. REYNOLDS said that during recent years he and his colleagues had done a quantity of work with a view to obtaining test-bars which would indicate the quality of the metal for pressure tightness, and it seemed that the only safe policy was to check by the use of pilot castings. Very disappointing results had been obtained in castings, even though test-bars had indicated that the metal was quite satisfactory. Castings which had failed under pressure had been examined under the microscope, and it had been difficult to find evidence of micro-porosity, etc., although it was there. Thus, his firm had given up forecasting from test-bars the pressure-resisting qualities of the castings.

MR. PECK said the work done at the B.N.F.M.R.A. by Baker, Child and Glaisher had shown that it was possible to make castings pressure-tight by having a small amount of gas present and that a small amount of gas altered the distribution of the porosity. They had controlled the gas content by adding small amounts of phosphorus.

MR. STOKOWIEC said that pressure-tightness could be controlled by melting conditions, but he never accepted a result from test-bars as an indication of the pressure-tightness of a big casting; one could not be satisfied unless the casting was submitted to hydraulic test.

MR. A. R. MARTIN suggested that possibly the speakers were discussing two different issues. The question to be answered was—what information can be expected from a tensile test-piece? Did foundrymen expect to learn how much gas was contained in the melt or to determine the tensile properties of the melt? Impurities had a pronounced effect on the tensile properties of aluminium alloys and a tensile test-piece should be capable of indicating their effect on the tensile properties of the alloys. No test-piece would give a really satisfactory indication on the amount of gas contained in a melt because of its small size. Other, more satisfactory, tests of gas content should be devised which could give a better indication of the soundness of larger-section castings.

MR. PECK did not think there was any hope of arriving at a test-bar which would show whether or not a casting was pressure-tight; what was being sought was a test-bar which would indicate melt quality.

MR. WEAVER asked whether Mr. Peck would expect to get the same relative results from sections of a casting as from the test-bars melted in bulk; and, on Mr. Peck indicating that he would not expect it, he suggested that the wedge bar did not reveal much in relation to the casting.

MR. PECK pointed out that a test-bar would not indicate the strength of the casting because of the variations in the running and feeding.

MR. WEAVER then remarked that the test-bar had no bearing on the quality of the casting.

MR. PECK said it had a bearing on the quality of the metal.

The CHAIRMAN commented that Mr. Mochrie was right in thanking the Authors for having recorded their data. No doubt Mr. Peck would agree that finality had not yet been reached; but the Paper was valuable for other workers on the problem to have on record the work done at the B.N.F.M.R.A.

Ring Tests

Mr. E. R. Evans, writing in the June issue of the British Cast Iron Research Association *Journal of Research and Development*, has summarised his conclusions on the relation between test-bar and ring tests in the following statement:—The mechanical properties of four grades of cast iron have been determined from ring-type test-pieces, bar-type test-pieces machined from the same castings and bar-type test-pieces machined from separately-cast test-bars. Owing to the fact that distortion of the ring test-piece occurs under diametrical, tensile loading, the theoretical formula for the maximum stress,

$$f = \frac{PD}{746.6\ bt^2}$$ gives high results.

The usually accepted formula for piston-ring specifications,

$$f = \frac{PD}{1200\ bt^2}$$ also gives high results.

This variation is apparently due to the non-elastic behaviour of cast iron and two factors which are partly dependent on this:—

(1) As the test ring is stressed, distortion occurs and the effective radius of the ring is decreased, thus decreasing the bending moment on the ring for a given load. Ignoring other influences, the usually accepted formula allows for a decrease of effective radius to 0.62 of the original radius, whereas a reduction of from 0.54 of the original radius for high-grade materials, to 0.38 of the original radius for low-grade materials, seems to occur.

(2) Where very great distortion of the ring occurs and the effective radius becomes very small, the test approaches a direct tensile pull on the section of the ring and the bending moment becomes small.

The relative effects of the above factors depends on the amount of distortion of the ring, as the accepted formula is most nearly correct for thick rings, which show less distortion than thinner rings, especially in the case of high-grade materials. A more correct formula for thinner rings of high-grade materials is,

$$f = \frac{PD}{1400\ bt^2}$$ varying to $f = \frac{PD}{1950\ bt^2}$

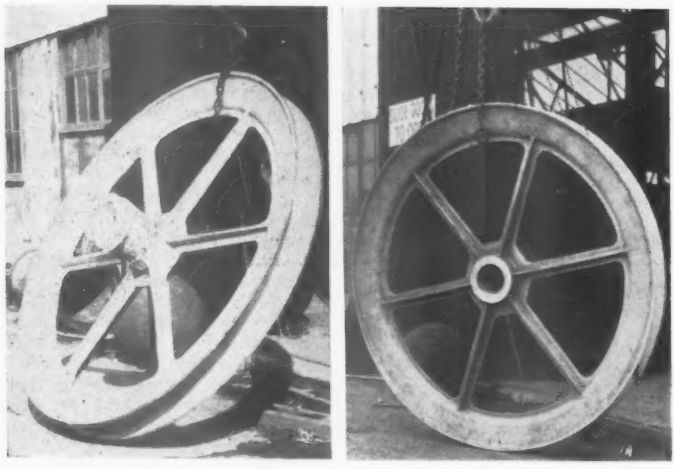
for lower-grade materials.

The tensile strength of a material as measured on test-pieces machined from the centre of a casting is less than that on test-pieces machined from near the surfaces of the casting. This may be the result of differences in the cooling rate of different parts of the casting, and is partially confirmed by comparison with results from test-pieces machined from separately-cast test-bars which had similar and dissimilar cooling rates to those of the casting.

There seems to be but little variation in the modulus of elasticity values of a material, whether determined by one of two methods on ring test-pieces or by tests on bar-type tensile test-pieces.

Large Aluminium-alloy Pulley

From the firm of Garton & King, Limited, of Exeter Foundry, Exeter, which was established in 1661 and thus must surely rank amongst the oldest concerns in the industry, comes a photograph of their latest casting. It was made against an order received from Johnson & Phillips, Limited, the electrical engineers and cable makers of Charlton. The illustration shows (left) the pulley as-cast and (right) after machining. It was made in D.T.D. 424 aluminium alloy furnished by the British Aluminium Company, Limited. The casting illustrated is 7 ft. 0½ in. outside diameter, and 6 ft. 0½ in. at the bottom of the groove. It weighed before machining 5 cwt. 1 qr. 10 lb. It is to be used for the production of seamless aluminium-sheathed cables—a type of cable of which Johnson & Phillips were the pioneers and one which can replace the orthodox lead-sheathed cable. A repeat order for the pulley has been secured.



Aluminium-alloy Pulley, 7 ft. 0½ in. dia., before and after Machining.

Loam and Dry-sand Moulding in the Jobbing Foundry*

By D. Redfern

THE FOUNDRY considered is a typical heavy jobbing shop, where castings ranging from two tons up to 40 tons in weight are produced, with the average weighing from 3 to 15 tons. The examples quoted are the type of casting usually handled in a foundry of this nature and deal with castings made in dry-sand and by loam moulding, one being a double cylinder block for a Diesel engine and the other a water box.

The approach to the job is first the enquiry from the customer, accompanied by the blueprint; by this print, the job is estimated, moulding technique is devised, a decision is made as to which moulder is best suited for the job, and all the usual queries arising are dealt with. After the decision on the most suitable method is arrived at, the price to be given on piecework is estimated and then the cost of the casting is intimated to the customer.

Cylinder-block Casting

As near as possible, the progress of the jobs will be taken step by step, the cylinder block first. The pattern shown in Fig. 1 conforms to the shape of the casting in outline, the crown of the pattern is dowelled and is held in place by dog clamps; the core prints that are visible take the inlet and port cores. A drag part 6 in. deep, is laid down and is rammed up about 4 in. and strickled level with a straight edge; the pattern is then placed on the bed so made crown down or in the reverse position to that shown in Fig. 1. Hand ramming is then carried on until the top of the flange is reached, when the screws are removed from the flange; then ramming is continued up to the first flange on the main body of the pattern and the screws are then removed from this section. A mid-part is then set into place and ramming continues up to the top of this part, care being taken to remove all screws from loose pieces and core-prints. On reaching the top of the mid-part, the first joint is made.

On this joint, a grating, cast to shape, with hooks and malleable irons cast-in, is placed (Fig. 2). After ramming in place, the upper mid-part is then set in position, and rammed up for about 12 in., when the malleable irons are bent over the box side to hold the grid in position. Next, the box is rammed up, carrying up the runner sticks with the sand. The top joint is then made, and two drawbacks are formed over the top-part core-prints. The top-part is then rammed up and ramming is completed. Finally, the top-part is finished and blacked, inlet runners are cut, vent holes are cut out and a groove is made to stamp the top joint. Toggles are forced into the eyeholes of the grating hooks and secured to the box side. The pattern is then drawn and the mid-part is taken away, finished and blackened (Fig. 3). The loose pieces and the crown section are then removed from the drag; this is finished and blackened and is then ready for the stove. (Fig. 4.)

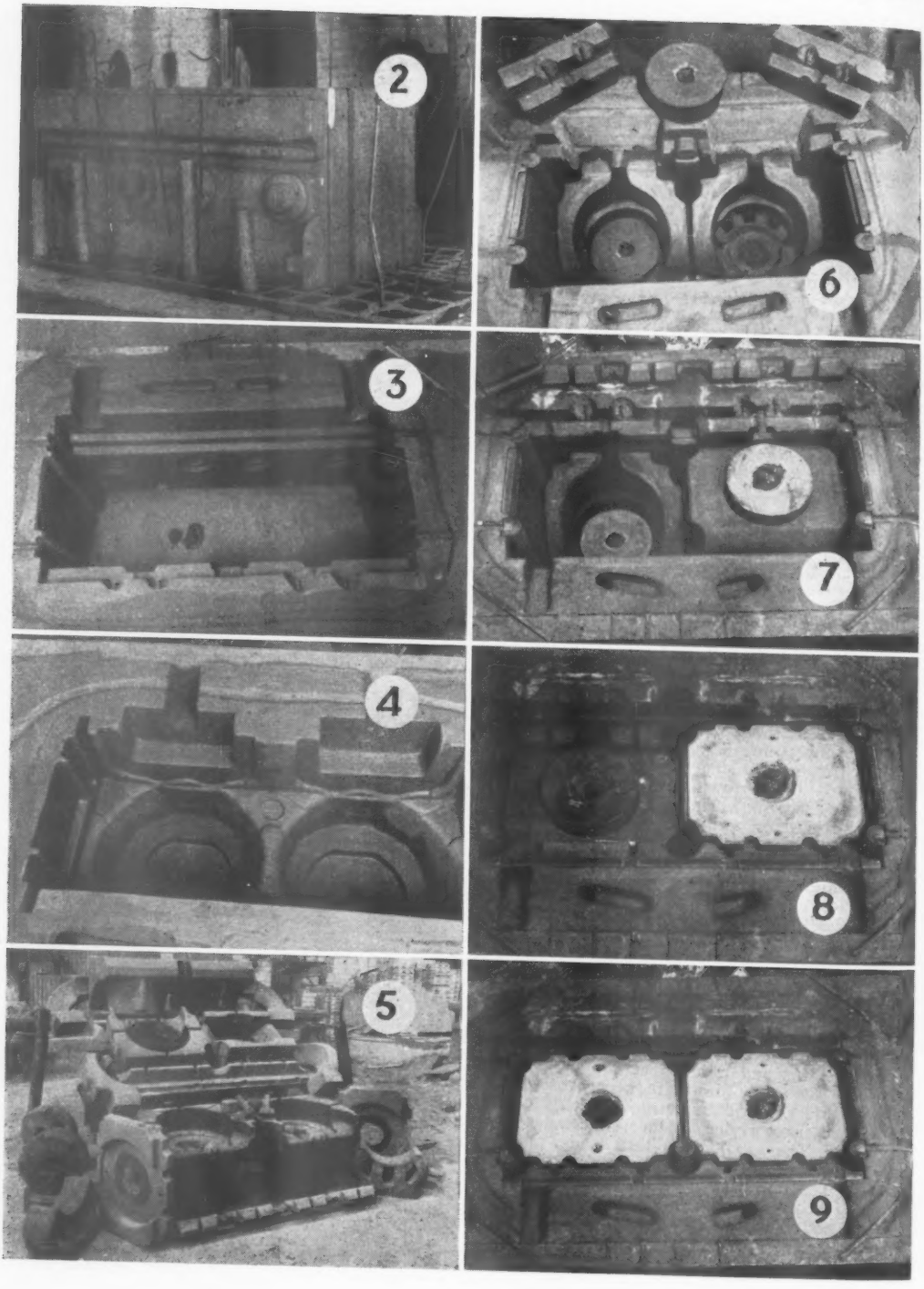
Cylinder-block Cores

There are more than forty cores in this casting (Fig. 5), and coring up is commenced by inserting the lower section of the panel cores and the bolting-down cores at each end of the mould; next, the two crown cores are set in position and the centre hole is filled with ashes. On the recessed seating, the lower part cores are set and fixed into the core prints. The small cores that connect with the water jacket are placed in the prints, and on top of these the water-jacket core is set supported on chaplets. All vents are made up and the mid-part is placed in position.

The next one is the barrel core, which forms the lower barrel for the liner, and finally the top-

FIG. 1.—*Pattern for a Cylinder-block Casting.*

* Paper read before the Scottish and Lancashire branches of the Institute of British Foundrymen.


2
6
3
7
4
8
5
9

part cores are set. Here becomes apparent the reason for the drawbacks, they are to allow the cores to enter the prints. The bodies of the port cores are supported by chaplets, these chaplets also hold the water-jacket cores in position as the metal rises. (Fig. 6.) Vents from the port cores are carried to the outside; the top halves of the panel cores are set; drawbacks are replaced and the joints sealed. Ashes are carried up through the centre of the barrel-core and the main cores are set. Then the top portion of the barrel-core is placed in position (Fig. 7), various small cores are set, and also the cores which form the internal flange at the top of the casting (Fig. 8). The two top cores are then set over the whole assembly and the last cores to be set are the long bolt-hole cores in the centre; these are also secured in position by chaplets. (Fig. 9.) The toggles are then

FIG. 2.—*Grating with Hooks and Irons placed on the Mid-part Joint.*

FIG. 3.—*Mid-part of the Cylinder-block Mould ready for the Stove.*

FIG. 4.—*Drag-part ready for Drying.*

FIG. 5.—*Some of the Forty Cores for the Cylinder-block Casting.*

FIG. 6.—*Interior of the Mould, showing the Barrel and Port Cores set in position.*

FIG. 7.—*Second Stage in Core Placing; note the Ash Vents for the Barrel Cores.*

FIG. 8.—*Third Stage in Core Placing; the Internal Flange Cores can be seen.*

FIG. 9.—*Final Stage in Core Assembly. Both Top Cores are in Position as well as Cores for the Bolt Holes.*

removed, the vents are made up and the joints sealed. The top is tried on and stamped; after examination, it is lowered on the box for the final closing, is clamped, and the mould is cast.

A view of casting showing the ports, is given in Fig. 10. A second view showing the cylinder barrels and the water way is shown in Fig. 11.

Water Box

Most foundries which normally make heavy castings will be familiar with the methods adopted to mould from a skeleton pattern, and to such foundries the use of strickle boards also will be quite common. What follows is an example of the use of both these methods whereby two halves of a water-box casting are cast in the same mould. A finished water-box casting is shown in Fig. 12.

A bottom plate is laid on a level bed in the moulding pit and to this a double cross is secured, the distance between the spindle sockets in the cross is equivalent to the width of the division cores which form the two halves of the casting—4½ in. When the cross is set and the spindles are plumbed true, the board for sweeping the seating is set and checked with the gauge or size stick—the bearing is then built up 5 in. high and strickled level with the sweep board. On this seating, the two branch

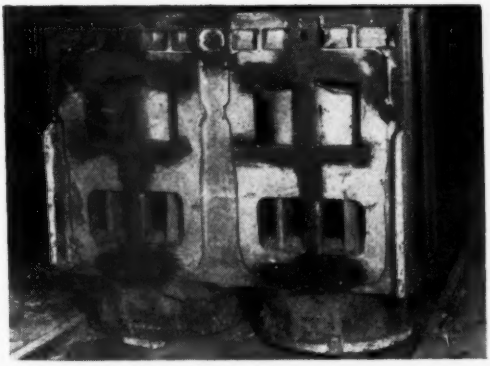


FIG. 10.—*Finished Cylinder-block Casting showing the Ports.*

sections of the pattern are set, these are then checked by the patternmaker, who also sets up the centre section of the pattern on bricks level with the cope seating—the bottom flange segments are then placed in position (Fig. 13). The assembled

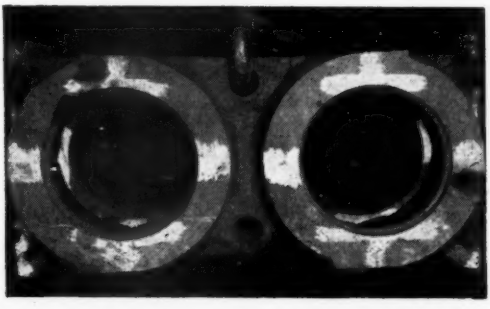


FIG. 11.—*Internal view of the Cylinder Block showing the Barrels and the Water Spaces.*

layout is then left for a period to harden and is again checked for discrepancies approx. 12 hrs. after being laid in position. Any faults due to shrinkage or drop due to the weight of the pattern

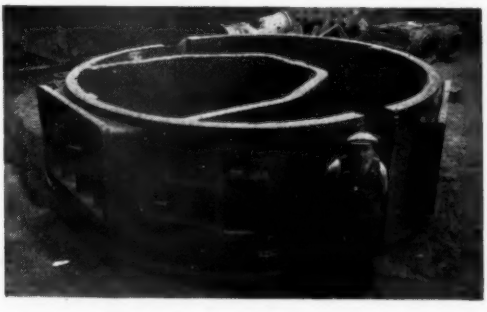


FIG. 12.—*Finished Water-box Casting, weight 9 tons.*

FIG. 13.—*Skeleton Patterns set for Moulding the Water-box Casting.*

are then corrected and the centre section is removed and the building of the cope commenced.

Building the Cope

A brick wall 12 in. wide is built to the outside circumference and, under the branch pieces, two gratings are bedded on loam 3 in. below the metal face; these are then packed with loam brick to the face of the pattern. Building proceeds and, on every two courses, building rings made of cast iron are bedded down on a loam bed about 1 in. thick, until the level for the seating of the inspection doors is reached. The loose pieces that form the doors are set in position (Fig. 14) and the building of the cope is carried up to the top joint. At various stages, the face of the mould is roughed up as the work proceeds and checked with the size stick for accuracy.

On completion of the cope, the centre section is replaced on bricks and the seating is built up to the underside of the flange on which the pattern is set. The open panels are then rammed with sand level with the pattern face. The internal joint is made below the bottom flange and a bed of loam 2 in. thick is laid on top of this joint face, the lifting plate for the centre drawback* is set and the building of the drawback is started. The drawback is built solidly over the plate, the bricks have the joints filled with loam up to 9 in. from the pattern face, the remaining joints between the bricks are filled with dry ashes. When the building reaches the level of the lower internal face of the branch, a grating is set on loam, this grating extends the full length of the branch and has recesses to take the brackets which extend the full depth of the branch; this grating is then toggled to the bottom plate, from this point the building proceeds. The centre of the drawback is left open about 3 ft., this facilitates drying and venting.

Provision for Contraction

At four points equally spaced, a cast-iron bar (Fig. 15), vee-shaped, is built in with the brickwork, 2 in. from the face of the pattern. The side of the bar nearest the pattern has brads cast into the face to secure the loam. These bars are so used to help release the bricks to allow the casting to contract without danger of cracking. The two drawbacks which form the internal wall are then built up with their joint on the centre line; the drawback which carries the second branch is built in a similar manner to that previously described. These drawbacks contain the main down-gates—eight in number. The runners are so distributed that the main shell and the centre section are cast simultaneously.

Joints are then cut over the branch casing and two drawbacks are built over the flange to facilitate the coring up when closing; the top joint is made and the top box is placed over the mould and rammed up in sand.

Mould Finishing and Drying

After ramming, the top is taken off, turned and finished; the drawback over the flange is lifted and

* Some founders will no doubt refer to these drawbacks as cores.

FIG. 14.—*Building the Cope of the Water-box Mould.*

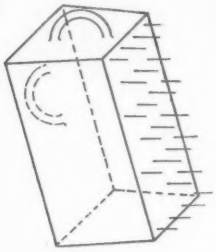


FIG. 15.—*Sketch of Cast-iron Bar, one of four built into the Brickwork of the Mould and later removed for releasing Stresses during the Cooling.*

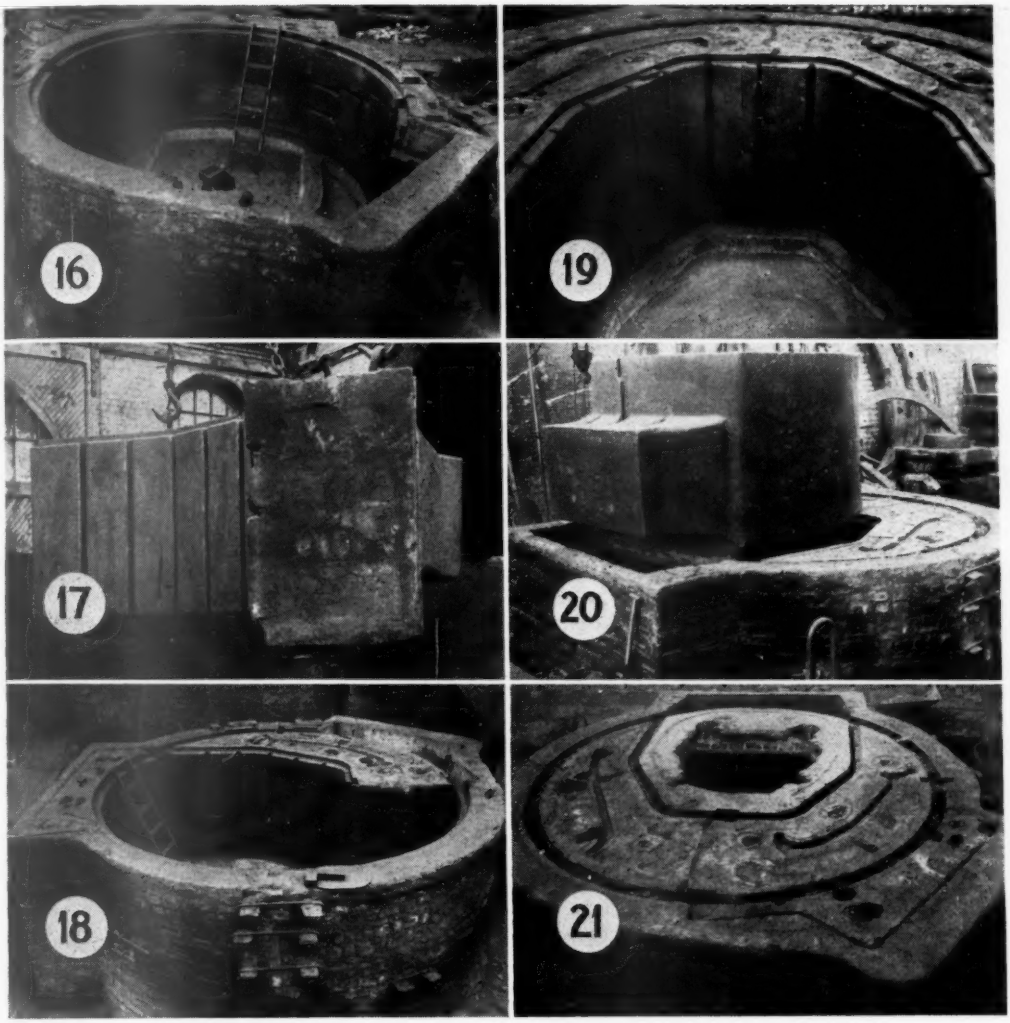


FIG. 16.—*Cope Mould for the Water Box after Drying, ready for the Drawbacks.*

FIG. 17.—*Close-up of the Branch Drawback suspended from the Crane.*

FIG. 18.—*Branch Drawback in its final Position in the Mould.*

FIG. 19.—*T-shape Cores set in advance of the Centre Drawback and secured by Chaplets.*

FIG. 20.—*Centre Drawback being lowered into place in the Mould.*

FIG. 21.—*Drawbacks in Position ready for the final Closing.*

the first drawback is lifted from the centre, the second from the plain side and, finally, the last to be removed is the drawback carrying the branch. The drawbacks are placed on the carriage, are finished off and black-washed while "green" and stoved. The cope left in the pit, is finished and black-washed also in the "green" state and is dried with portable dryers, using forced draught.

Closing

When the mould has been thoroughly dried, the dryers are taken away and the mould is cleaned up. The cores are set in the inspection door prints and bolted into position outside the cope face (Fig. 16). The first drawback to be reset is that which carries the branch (Fig. 17). This drawback is set in position with clays on the lower-branch

FIG. 22.—*Water-box Casting; Setting the Segment Patterns for the Second Method of Moulding.*

section and the sides being checked for the 1¼ in. metal thickness. The drawback is then removed temporarily, while chaplets are placed under the branch core and the drawback is finally lowered into place (Fig. 18). The plain half-drawback, is the next one to be set in its position; T-shaped cores are set in the centre to give an internal flange on the inside of the centre drawback, these cores being secured by chaplets (Fig. 19). The centre drawback is the final one to be lowered into place; it is taken over the job (Fig. 20) and then lowered into place (Fig. 21). The drawbacks are then secured over the prints of the branches and all joints are made good, meanwhile, the ramming up of the outer part of the pit is in progress and the centre hole in the main drawback is filled to 4 in. below the level of the top joint with bricks and ashes. A tube, 8in. diam. is upended in the centre and the hole is then rammed up to the level of the joint face with sand. The final cores to be inserted are those forming the division between the two halves of the casting. The top part next is tried on, withdrawn temporarily, and all waste is removed. The vents are stamped and the top is lowered on for the last time. Finally, the mould is bound and reinforced with external tie bars and then is cast.

Baring the Casting

Two hours after casting, the pit is opened-up opposite the two branches down to the level of the lower face. The binding bars are removed and the top is taken away. The bars shown in Fig. 15 are then pulled out by the crane. The top gratings on the drawbacks are broken and the drawbacks are bared from the top to the centre of the drawback branch cores. Simultaneously, the mould is broken through on the outside from a point opposite the branch. All internal gratings are broken and the bricks are removed, leaving a hole through the branch core to connect with the hole driven through the drawback. This procedure is essential to permit contraction, ensuring that there is no hard core to impede movement and cause the casting to crack.

Second Method

Two water boxes were required, the second being made in a different manner. The segments were set as before (Fig. 22), then the centre section was set on its bed (Fig. 23), after which the drawbacks first were built in a similar manner to the original casting (Fig. 24). After completing the drawbacks, the mould was then rammed up in sand instead of being built in loam as in the previous instance.

The finishing, closing and casting were similar to the methods used for the first one made. Comparisons with the time taken for each casting showed little variation, that produced by ramming the cope took a shade less time than the one moulded in loam. The weight of the finished casting was nine tons.

Some Old Timers

Foundrymen have often heard the accusation that in past years founders were quite content to work by rule of thumb, costing systems, metallurgical control and the commercial methods used being very crude. The foundry with which the Author is associated has operated over a period of fifty years and a short time ago some photographs were discovered of castings that were produced in this foundry. On consulting the books, the Author found a wealth of detail about each casting and he believes these particulars will be of great interest. The first casting was an M.P. Cylinder with casing combined made in August, 1907 (Fig. 25). For loam moulding the time taken was:—mould, cores, dressing 134 days or 1,206 man hours; metal taken to cast the job was 14 tons-mixture: 6 tons No. 3 Carron pig iron, 3 tons Carronboro' pig iron and 5 tons scrap; cost of melted iron 61s. per ton;

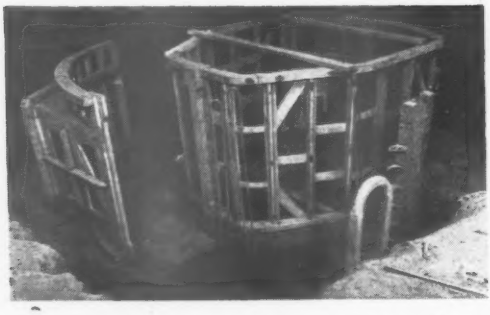


FIG. 23.—*Centre-section Set on its Lifting Plate.*

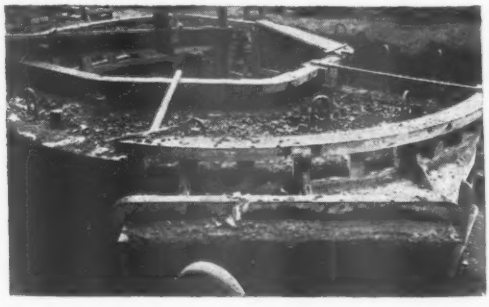


FIG. 24.—*Building-up the Drawbacks (Second Method).*

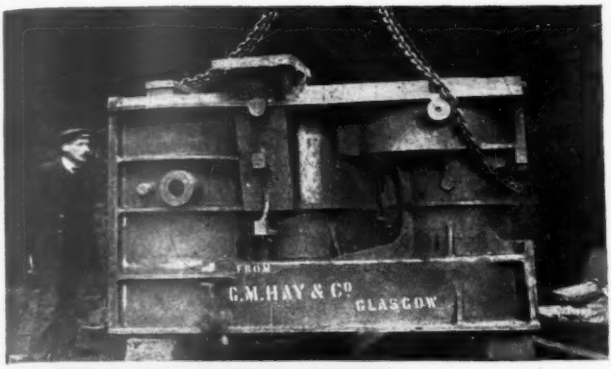
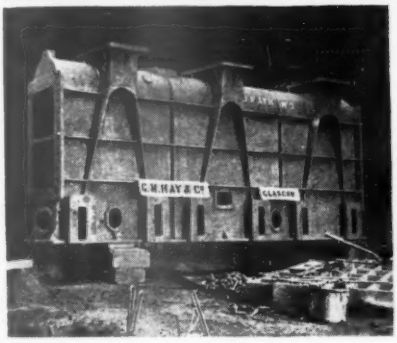
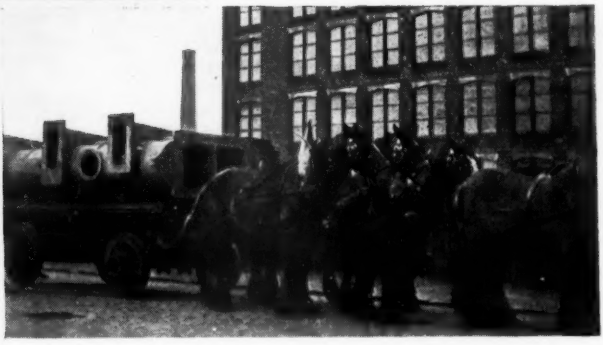


FIG. 25 (*left*).—25 M.P. *Cylinder Casting with Combined Casing.*

FIG. 26 (*lower left*).—*Condenser Body, weight 9 tons 15 cwt.*

FIG. 27 (*below*).—*Old-time transport of Large Castings by Horse-drawn Wagon.*





weight of finished casting 12 tons, 3 cwt. Sale price of the casting was 15s 6d. per cwt.

The second of these castings was the top half of a turbine casing, sand moulding was used and in time taken for moulding, coremaking and dressing was 30 days or 270 man hours; the weight of metal to cast was 4 tons; the mixture being 30 cwt. Carron No. 3, 30 cwt. Carronboro' pig iron, and 30 cwt. scrap. The cost of the melted iron was 61s. per ton, and the weight of the finished casting was 2 tons 12 cwt. at a selling price of 17s. per cwt.

A third example was a condenser body shown in Fig. 26. for which loam moulding was used, the time taken for moulding, coremaking, and dressing was 93 days, or 837 man hours; the weight of metal required to cast was 15 tons, the mixture used—4 tons Carron No. 3 pig iron, 6 tons Carronboro' pig iron, and 5 tons scrap. The cost of the melted iron was 61s. per ton; the weight of the casting, 9 tons 15 cwt., and the sale price 15s. 6d. per cwt.

Included in the records are the names of the moulders who made these castings, with remarks on methods of moulding and any occurence out of the ordinary, together with notes on how any future castings from these patterns should be moulded. The only figures not available were transport costs and as the illustration shows (Fig. 27), this was probably based on horse power.

Clyde Shipbuilding

Clyde shipbuilders have received orders far in excess of expectations this year, although few have been given to small firms. A. & J. Inglis, Limited, Glasgow, have received an order to build two whale catchers for United Whalers, Limited, London. Two twin-screw motor vessels have been ordered by the Turkish State Seaways & Harbours Administration from Wm. Denny & Bros., Limited, Dumbarton. These are the first merchant vessels to be built for Turkey by a British shipyard for 30 years. Henry Robb, Limited, have received an order for four Diesel-engined tugs for Manchester Ship Canal Company, Limited, and Lithgows, Limited, Port Glasgow, have received an order for a 16,500-ton tanker. The order has been placed by the Silver Line, Limited, London, and propelling machinery will be provided by David Rowan & Company, Limited, Glasgow.

James Lamont & Company, Limited, Port Glasgow, have received an order for the building of a 100-ton passenger and car ferry for Kessock Ferry Joint Committee. Propelling machinery of 160 b.h.p. will be supplied by Gleniffer Engines, Limited, Anniesland, Glasgow. An order valued at £2,000,000 for three cargo/passenger liners, each of 6,650 tons gross, has been placed by Clan Line, Limited, with two Clyde yards. Two of the vessels will be built by John Brown & Company, Limited, Clydebank, and the other by Greenock Dockyard Company, Limited. Propelling machinery for the new ships will be of the "McI" class and will consist of 6-cylinder Doxford oil engines giving a service speed of 15 knots. Machinery for all three will be provided by John Brown & Company, Limited.

British Non-ferrous Metals Federation

THE ANNUAL general meeting of the British Non-ferrous Metals Federation was held last Thursday, Mr. W. H. Henman being re-elected as president. In the course of his presidential address he said:—

I have spoken of some of the differences in atmosphere and outlook which have grown up in the last fifty years, but there is one outstanding change of a practical kind which will serve as a peg on which to hang some of my remarks to-day. I refer to the cost of the metals in which we work. When I was a young man, copper cost about £50 to £60 a ton, and zinc about £20 to £25. We can most of us remember the days in the early thirties when copper went down to £25 a ton and zinc to £9. In those days, it was still possible to regard the non-ferrous metals as base metals. To-day they have almost entered into the realm of semi-precious metals, because at the present time the price of copper is £186 a ton and the price of zinc is £127 10s. Copper is only a few pounds below the record price which it reached during the continental blockade during the time of the Napoleonic wars, when manufacturers were forced to melt down the copper coinage of the realm whose face value was less than its copper content. Zinc, on the other hand, is already far above any figure which it has ever reached in the history of the metal.

Disadvantages of Bulk Purchase

The general changes which have taken place in the value of money and in our conceptions of cost and worth will, of course, account for some increase such as we have seen in most commodities, but the present astronomical figures are not due solely to monetary causes; still less are they due to any natural cause in the way of absolute shortage or of insuperable mining difficulties. They are due, first and foremost, to the fact that we are still, five years after the end of the war, operating under the wartime system of bulk purchase. The London Metal Exchange is closed for dealings in copper and zinc and, under the arrangements made between the Ministry of Supply and the Empire producers, the price paid for the whole of our imports is linked at a devalued rate of exchange to the transatlantic price.

This price itself is largely influenced by the stockpiling policy of the American Government and bears no direct relation to production costs. The Ministry of Supply is to-day taking approximately £6 a ton above the f.a.s. New York price for copper and £7 10s. a ton for zinc. There is every reason for alarm at the high level of costs to-day, especially when it is borne in mind that the element of raw material accounts for anything up to 90 per cent. of the cost of the articles which we sell. Moreover, this heavy burden is one which has to be borne by all the manifold and varied industries which use our finished products and which include some of those which are making the most valuable contribution to British exports to-day.

It is well that I should utter a word of warning, not only to those engaged in the fabricating industry, but also, if my words will carry that far, to the Ministry of Supply, and to the producers themselves. It is an inescapable economic law that where the price of an article remains for a long period substantially out of relation to the price of its potential substitutes the user is bound to turn to such substitutes. We here know that for practically all its present applications, there is no acceptable substitute for copper and its alloys, but there are several materials which are not a bad second best for certain purposes, and one can foresee a situation in which British Industry might well be compelled, for the reasons of price, to turn to new materials, to the detriment not only of our own industry, but also, in the long run, of their own products which would be less efficient for their purpose.

Handicaps to Home Manufacturers

Such a situation, if carried too far, might at no very distant date have very serious repercussions on the world mining situation, and if a number of our mills were forced to close down, on the strategic position of this country and her allies near and far. I cannot too strongly emphasise the Federation's view that it is vital that the prices of copper and zinc, and other non-ferrous metals, should come down to a more reasonable level at the earliest possible moment.

I have so far been speaking chiefly of the absolute level of prices, but it should also be borne in mind that manufacturers in this country are in certain respects at a disadvantage compared with those in other countries who are able to obtain their raw materials at prices more closely in line with the so-called world price. This disparity might well develop into a serious competitive weakness for the exporting industries of Great Britain.

This is perhaps an appropriate moment to pay tribute once again to the excellent understanding which exists between the representatives of the Ministry of Supply and of the Federation who are in the habit of meeting at regular intervals to discuss the problems of the industry. So far as it is possible, within the limits of Government policy, with which we do not agree, we find the officials of the Ministry of Supply most helpful and understanding. I should mention one important point in connection with price levels in which the Federation has obtained a certain degree of satisfaction from the Ministry. I refer to the premiums for forward purchase which, on our representations, were recently substantially reduced, thereby minimising to some extent the disadvantages at which we have been placed. This is a step in the right direction and we welcome it as such. We are, however, still constant to our conviction that the only way to restore sound health to the metal world is to put an end to the present system of bulk purchase, and to restore free trade in all metals.

Metal Crucibles for Melting Aluminium Alloys*

By Jean Duport

GRAPHITE CRUCIBLES were in short supply in France in the post-war years and metal crucibles were extensively used. At the present time, the situation is much better, and for high-grade casting, graphite crucibles are to be preferred. The price for the usual sizes of grey-iron crucibles was about the same as graphite, unless the "rapid-heating" or silicon-carbide varieties were called for. It would appear that if iron crucibles can give about the same life as graphite they should be used. Moreover, it should be realised that with metal crucibles there is required neither a stool nor an upper extension. The mechanical strength of such crucibles is generally superior to either graphite or silicon carbide. The advantage works out well for the founder who carries out the re-melting of thin sections or turnings, where it is necessary to use furnace tools quite frequently which have been on the top edge of the crucible or its extension. The melting times shown by metal crucibles under parallel conditions are much the same as those given by new rapid-heating graphite varieties. These times remain constant with iron crucibles throughout their life, whilst those of graphite or silicon carbide rapidly age and lose some of their heat conductivity. Thus the melting time in furnaces of 750 points† is about 70 min. with new graphite crucibles, but increases to 1¼ hours after making about 30 charges. Silicon-carbide crucibles, which age more slowly than graphite, will take about 75 mins. when new and 1½ hours after some use. When using metal crucibles, there are never any complaints from the machine shops that bits detached from the crucibles show up as inclusions in the castings. Finally, from the purely metallurgical point of view, the use of metal crucibles requires that users must carefully avoid any overheating which would introduce an unwanted pick-up of iron and a reduction in the life of the crucible.

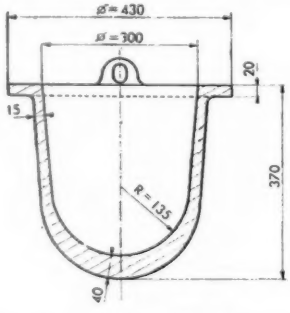


FIG. 1.—*Melting Crucible of* 150 *Points. This Model is Poorly Designed, the Concentration of Metal at the Bottom being Wasteful and Dangerous.*

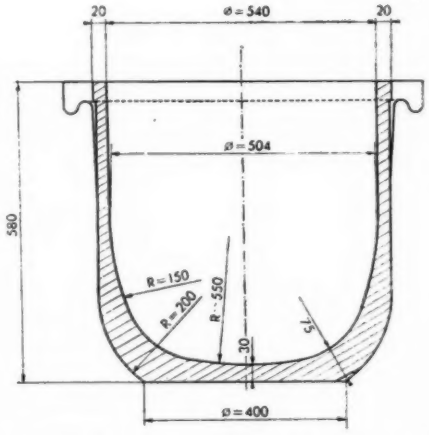


FIG. 2.—*Badly Designed Holding Crucible of about* 600 *Points, with Irregularities in Thickness and Angles of the Lower Part.*

Drawback

The outstanding disadvantage is undoubtedly this iron pick-up. Amongst others, there is the need of a suitable dressing. It should be remembered that the iron pick-up is not serious below 800 deg. C.—a temperature beneath which many alloys can be made. Again, some alloys, such as RR53, Novalit and RR50, can carry a modicum of iron without detriment. However, the French, rightly or wrongly, are much stricter as to iron content than either the British or Americans, where from 1.20 to 1.50 per cent. is permitted in a number of foundry alloys. The Author cites three cases from practice: (1) Using an iron holding furnace for 21 days for the casting, a high (18 to 20 per cent.) silicon alloy, the following figures resulted:—

Weight of liquid metal cast	7½ tons.
Weight of castings made	2½ tons.
Iron content in the castings,	0.80 to 0.90 per cent.

* An abridged translation of an article printed in "*Fonderie*."

† "Points" we understand to be the size of the crucible related to brass capacity in kilograms.

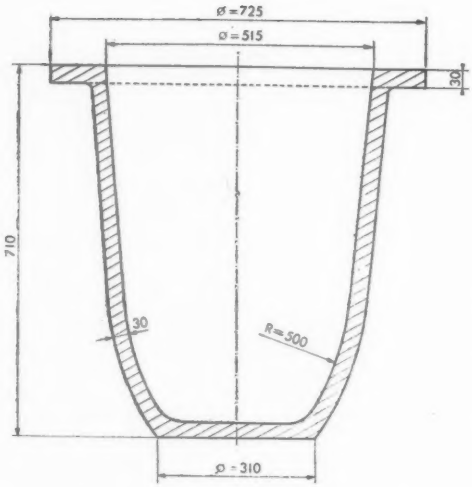


FIG. 3.—*This Melting Crucible of* 800 *Points is an Improvement on those shown in* FIGS. 1 *and* 2. *Nevertheless the abrupt Changes of Section in the Lower Angles should have been avoided.*

Using the silicon-carbide crucibles, the average iron content would be of the order of 1.60 to 0.70 per cent.

(2) During the course of a test made on a ferritic cast-iron crucible carrying a high percentage of chromium using a tar-oil-fired plant for melting a silicon alloy of the following composition: Fe, 0.60 max.; Si, 10 to 13; Cu, 0.10 max.; Mg, 0.20 to 0.40, and Mn, 0.40 to 0.50 per cent. for ingot making, refined with Pacz powder, there was obtained the following results when using crucibles dressed every morning:—

Max. crucible temp. in deg. C.	Iron content, per cent.						
	1st melting.	2nd melting.	3rd melting.	4th melting.	5th melting.	6th melting.	7th melting.
800 to 820	0.50	0.54	—	0.55	0.59	0.60	0.60
900	0.52	0.55	0.58	0.60	—	—	—
950	0.52	—	0.60	0.68	—	—	—

(3) Using the same type of high-chromium iron crucible, but in a gas-fired furnace and held at 700 to 750 deg. C. for A540 alloy and dressed each night, no increase in iron content was observed.

Another possible drawback can be external scaling. Ordinary grey-iron crucibles, carrying on without a small chrome addition, do oxidise, especially in tar-oil fired furnaces, but the high-chrome material is highly scale-resisting. The importance of scaling may be appreciated from the following instance: An ordinary iron crucible weighing 80 kg. is received, produced 6.5 kg. of scale during its 200 hours of semi-continuous service.

A weekly cleaning of both the combustion chambers and the exterior of crucibles is recommended to minimise melting accidents. These can be somewhat alarming, as the reaction resulting from a broken crucible between the liquid aluminium and the iron oxide is somewhat violent.

Choice of Alloys for Crucible Melting

So far, there have been tried crucibles of grey iron, blackheart malleable, high-chrome ferritic irons and white iron. Bastien and Miss Daeschner have shown that so far as the Alpax type of alloy is concerned, steel and high-chrome ferritic iron are more seriously attacked than either grey or black-heart iron. It should be understood that the solution tests referred to only represent one of the aspects of the problem; but in addition to attack by liquid alloys, there are, in practice, other features such as mechanical stresses under heat and the action of the combustion gases.

Whilst, generally speaking, steel crucibles have been abandoned for some years now, those made from either RC 30 or "Ferchromit" (ferritic alloys containing 25 to 30 per cent. Cr) are still popular especially in Germany and Czechoslovakia. In France, various tests have also been carried out, which have shown that these alloys successfully resist scaling, but that it is desirable to protect the surface with a dressing.

Grey-iron crucibles must be selected with care so as to avoid those subject to growth. Thus choice is made of an iron with relatively high carbon so as also to resist thermal shock. This should carry a silicon content which will ensure a pearlitic structure. To stabilise the carbides, a small chrome addition is suggested. For crucibles of normal thickness, the following percentage composition is suggested:—C, 3.20 to 3.40; Si, 2.10 to 2.00; Mn, 0.70 to 0.90; S, less than 0.12; P, less than 0.30, and Cr, 0.40 to 0.60.

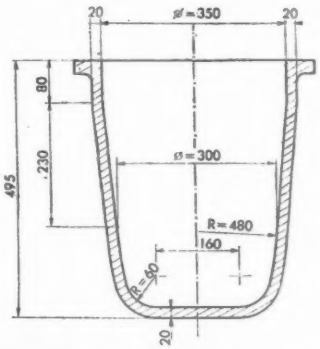


FIG. 4.—*Melting Crucible of* 200 *Points, well designed from the Point of View of Thickness. This Model would gain by being provided with a Heating Extension, as would those shown in* FIGS. 6 *and* 7.

White irons, having a high modulus of elasticity, have poor thermal-shock resisting properties and are liable to crack. One of the reasons for the good results (so far as iron solution is concerned) obtained with black-heart malleable is the nodular form of the graphite. Some tests have recently been inaugurated in a works using crucibles of 515 points made from grey iron, black-heart malleable, and ferritic, high-chrome iron. It is still too early, however, to draw definite conclusions, especially for the two last, for the conditions of working vary much from one foundry to another. Some of the crucibles had casting defects which lowered their life. As an indication, the results so far obtained are set out below:—

First Test

Conditions of Working.

Fuel used—tar oil.
Crucible size—515 points.
No. of melts per day—6 to 7.
Alloy melted—RR50.
Max. temperature reached—720 to 730 deg. C.
Dressing—three times weekly.
Type of crucibles used:—

	C.	Si.	Mn.	S.	P.
Grey Iron	3.15	2.10	0.59	0.06	0.21
Black-heart No. 1 ..	—	1.05	0.45	0.11	0.08
" " No. 2 ..	—	1.24	0.47	0.10	0.08

Grey-iron crucibles—averaged 100 melts per crucible, or about 14 tons of alloy melted.

No. 1 malleable—averaged 106 melts, or about 15 tons of alloy melted.

No. 2 malleable—averaged 77 melts, or about 11 tons of alloy melted.

Second Test

Conditions of working—same as for the first test, except:—

Max. temperature reached—720 to 750 deg. C.

Crucibles tested—ferritic high-chromium, having the following composition:—C, 0.50; Si, 1.50; Mn, 0.87; S, 0.02; P, 0.07, and Cr, 22.61 per cent.

Results.

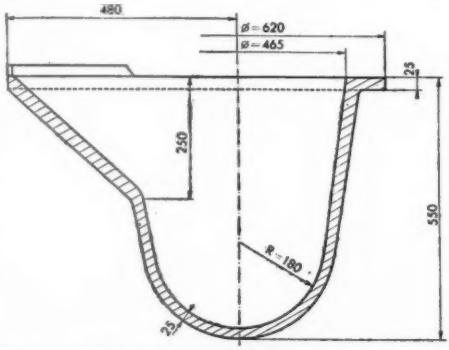


FIG. 5.—*Well-designed Melting Crucible of around 500 Points. This Crucible has been carefully studied from the point of view of Regularity of Thickness.*

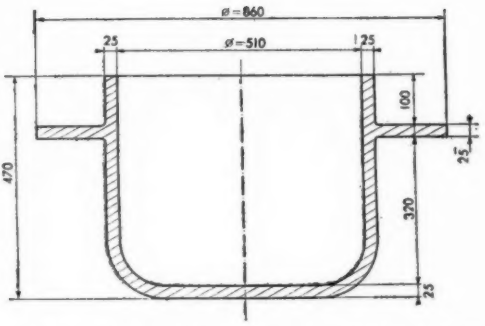


FIG. 6.—*This 300-point Holding Crucible is of Good Design.*

Crucible No.	Total No. of melts.	Alloy tonnage method.
1	14	2.0
2	6	0.8
3	23	3.3
4	37	5.3
5	46	6.5
6	15	2.1
7	69	9.8
8	140	20.0

This test should be ruled out because of the wide scatter in the results, due to bad founding practice. Actually, practically all the crucibles have been repaired by welding.

Aluminium Alloys Melted

Some aluminium alloys demand low iron content in order to withstand severe conditions of corrosion and other properties. Thus, metal crucibles should not be used for the melting of the following alloys:

A-U5GT (APM)—iron not to exceed 0.35 per cent.

A-S9KG (hypo-eutectic Alpax carrying cobalt)—iron not to exceed 0.45 per cent.

A-G3T—Iron not to exceed 0.40 per cent.

A-G6—iron not to exceed 0.40 per cent.

Ordinary Alpax, having manganese and magnesium, and where a 0.75 per cent. limit is placed on the iron content, seems to be about the limit for the use of metal crucibles.

Shapes and Sizes

Foundry defects—draws, blow-holes and the like—can naturally shorten the life of a metal crucible. Thus, in order to lessen the onus placed on the founder, shape and design should be studied so as to rule out heavy sections and abrupt change of sections (see Figs. 1 to 7).

Where flame melting is used (coke, tar-oil or gas), it is essential to provide the crucibles with an upper extension. The crucible should be suspended; metal crucibles should neither rest on a stool nor

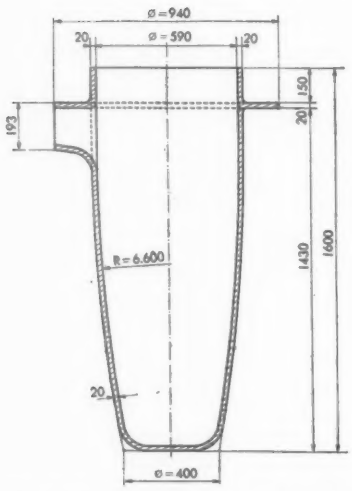


FIG. 7.—*Well-designed* 1,500-*point Melting Crucible, notable for its uniformly Thin Section throughout, permitting an average of* 150 *Melts.*

on the bottom of the furnace. There are now available furnaces of 1,500 points working under excellent conditions using suspended iron crucibles (Fig. 7). Some founders prefer the "finned" type shown in Fig. 8. Such a design does provide extra heating surface associated with decreased wear, but output figures for this type are not yet available.

Heating Methods

Amongst the various systems of heating available, the best crucible life is given by electric resistance furnaces—usually holding furnaces—and then by town's-gas-fired units. Generally speaking, good results are shown where there is equalisation in the application of heat and this is why stools are ruled out. Gas or tar-oil flames should be directed tangentially and never impinge at right-angles to the crucible. An increase in the number of burners in the case of the larger plants has shown advantages. Forced-draught, coke-fired furnaces often show hot spots and their use needs very careful control.

Precautions

No matter what type of crucible be used, thermal shocks must be avoided. Quite often, metal crucibles perish because of the cracking of the lower part due to violent temperature changes. Slags, oxides and metal residues have a tendency to cling to the walls of the crucibles. These can set up local corrosion during shut-downs, and so it is urged that after the last cast the crucible should be meticulously cleaned, either by using a metal scraper or by thoroughly washing with a flux capable of dissolving the oxides—to be done, of course, whilst the crucible is still sufficiently hot. Such a flux would be based on fluorides or a mixture of fluorides and chlorides. Proprietory brands are available in France.

After recalling the use of an increased number of burners and the direction of the flame, the Author then refers to the charging of the crucibles. Here, he recommends the placing on the bottom of the pot of small solid chunks of scrap—runners, risers and the like, and ingot metal. Then, after a liquid bath is formed, the larger pieces of scrap—maybe of awkward shapes—are admitted. Some foundries retain about a quarter or a fifth of one charge to give a good start for that following.

Finally, crucibles must be dressed with a refractory paint each evening. For the smaller and medium-size holding furnaces, it is suggested that two be provided for use on alternative days.

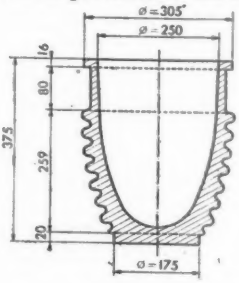


FIG. 8.—*Finned Crucible of* 100 *Points.*

Neophyte Architects Design a Foundry

Recently we spent a few very pleasant hours at the Architectural Association School of Architecture, 33-36, Bedford Square, London, W.C.1. Here the 4th year students had devoted a term to the designing of a mechanised foundry. The students were to use for their plans a site contiguous to an existing foundry and had to pay special attention to the provision of changing, washing and bathing facilities. The proposition was for a building to house a mechanised plant and a large hand-moulding floor capable of dealing with a hundred tons a week.

The students worked in groups of five on this—to our mind—very difficult proposition. The knowledge they had gained as to foundry requirements was truly remarkable. The best layout was perhaps the most orthodox. One group, which included a very charming girl student, decided that two floors would be satisfactory for a portion of the building. The raw materials were to be taken to the first floor by a heavy-duty bucket elevator—presumably mobile. This, of course, simply would not answer for an iron foundry, but there is a germ of an idea for a non-ferrous concern, where the positioning of a bonded store on the first floor would show material advantages. Then this group decided—after an inspection of some special wall material at the Building Centre, that it would be a good idea to provide a water spray so that the walls could periodically be washed down. The students had made beautiful models of their proposals. Obviously cardinal mistakes were made, yet in general there was a proper appreciation of the necessity for mechanical handling and the orderly movements of the various processes. It would be very interesting for the students at the National Foundry College to see this work, as they would learn to appreciate the need for giving to the architectural profession the essential data for proper co-operation. With a very minimum knowledge of the essential requirements, the students of the Architectural School well merit our congratulations personally accorded.

B.I.S.R.A. Appointments

At the annual general meeting of the British Iron and Steel Research Association last Wednesday, Mr. Richard Mather, chairman and managing director of the Skinningrove Iron Company, Limited, was elected to succeed Sir Andrew McCance, F.R.S., deputy chairman and joint managing director of Colvilles, Limited, as chairman of Council.

At a meeting of the Council held earlier in the day Sir Andrew was elected president of the Association in succession to Mr. G. H. Latham, chairman and managing director of the Whitehead Iron & Steel Company, Limited, who has held the office for the past three years. At that meeting, also, Mr. J. Mitchell, a director of Stewarts and Lloyds, Limited, was elected a new vice-president, and Prof. J. H. Andrew (University of Sheffield) and Mr. F. H. Saniter (United Steel Companies, Limited) were co-opted to the Council.

Nine new Council members were elected at the annual general meeting as a result of retirements made in accordance with the articles of association. The new members are:—

Brig. A. Levesley, a director of Edgar Allen & Company, Limited; Mr. D. A. Oliver, William Jessop & Sons, Limited; Mr. B. Chetwynd Talbot, deputy chairman and managing director of the South Durham Steel & Iron Company, Limited; Mr. C. R. Wheeler, joint managing director of Guest Keen Baldwins Iron & Steel Company, Limited; Mr. L. F. Wright, chairman and managing director of Gjers, Mills & Company, Limited; Dr. N. P. Allen, National Physical Laboratory; Dr. T. P. Colclough, British Iron and Steel Federation; Mr. J. F. R. Jones, John Summers & Sons, Limited; Prof. R. J. Sarjant, University of Sheffield.

Board Changes

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED—Earl de la Warr, P.C., J.P., has been appointed a director.

STEDALL & COMPANY, LIMITED—Major Leigh P. Stedall has retired from the board, of which he was chairman. Mr. H. S. O. P. Stedall has been elected chairman.

HADFIELDS, LIMITED, Sheffield—Mr. Arthur H. Waine has been appointed a director. Mr. Waine joined the company in 1917, was appointed a local director in 1945, and has been a director of one of their subsidiary companies—Hadfields Foundry & Engineering Company, Limited—since its formation. Mr. Waine has been closely connected with the metallurgical and production branches of Hadfields's business, having graduated through the chemical and research laboratories, during which period he gained at Sheffield University both the associateship in metallurgy and the associateship in mechanical engineering and was awarded the Mappin Medal.

Carbon Monoxide Detection

A new method of detection of carbon monoxide is described in a leaflet just issued by the Department of Scientific and Industrial Research. The leaflet (No. 7) is one of a series of 12 issued before the war under the title of "Methods for the Detection of Toxic Gases in Industry," and has been completely revised. The new test, which is simpler and more accurate than earlier methods, was developed during the war at the Royal Aircraft Establishment.

The leaflet has been published for the D.S.I.R. by H.M. Stationery Office, price 6d. Its importance since the recent report of eleven fatalities on the North East Coast cannot be exaggerated.

News in Brief

THE ASSOCIATION OF BRONZE AND BRASS FOUNDERS has issued as a document confidential to members a report from their technical committee on the operating costs of metal melting furnaces of the non-crucible type.

ZIRCONAL, LIMITED, have removed from Claver House, Wells Park Road, Sydenham, London, S.E.26, to 25, Clyde Vale, Dartmouth Road, Forest Hill, London, S.E.23. This has been necessary owing to the need for increased accommodation.

THE FIRST ANNUAL summer school of production engineering organised by the Institution of Production Engineers will be held at St. Peter's Hall, Oxford, from August 30 to September 3. The theme for the school will be the science and practice of engineering applied to production.

THE DEPARTMENT of welding engineering at Ohio State University, Columbus 10, U.S.A., announce that Engineering Experiment Station Bulletin 140, "Patent Classification in the A. F. Davis Welding Library," has been printed and is available on request. This publication gives the outline of the library's patent classification index and explains in detail the operation and use of the system. The bulletin is designed to assist external users of the index.

WIDNES FOUNDRY & ENGINEERING COMPANY, LIMITED, announce that, in view of the recent increase in the costs of rail and road transport, and the corresponding increases in the cost of materials and in the cost of delivery, the selling price of class A castings will be increased by 9d. per cwt. This increase will operate on all castings delivered on and after July 1. Special low-phosphorus and acid-resisting castings will be subject to special increases.

MACHINE PARTS for export to many overseas markets were involved in a recent £25,000 fire at the Monifieth Foundry of James F. Low & Company, Limited. The blaze started in the painting department about 4 p.m. and spread to the finished-part store, brass store, and part of the loading bank. The roof of the building collapsed before the firemen were able to bring the blaze under control, but the main shops, containing the firm's machinery and products at various stages of manufacture, were saved.

THE ANNUAL works excursion of Matthew Swain, Limited, ironfounders, cast-iron hollow-ware manufacturers and wire workers, of Newton Heath, Manchester, was held last Saturday week, when almost 200 workers were the company's guests for the day at Scarborough. At luncheon, the chairman, Mr. Matthew E. Swain, made presentations for long service to a number of employees. A special presentation was made to Mr. W. Oliver to commemorate the completion of 60 years' service. A sea cruise was arranged for the afternoon, and approximately half of the total party boarded M.V. Coronia for a two-hour trip.

THE PROGRAMME of the summer meeting in Birmingham of the Institution of Mechanical Engineers included a visit to the General Electric Company, Limited. The visitors were entertained to luncheon at the Midland Hotel, where they were received by Dr. C. C. Garrard, resident director, and Mrs. Garrard. After luncheon the party was taken by coach to the Witton works and escorted through many of the large factories on this site, including the transformer and switchgear works, heavy engineering works, rectifier and electronic works and the Witton moulded insulation works, where a display of the many products made was on view. The tour also included the company's high-power testing station and 2½ million-volt laboratory, where a demonstration of extra-high-voltage phenomena was given.

Personal

MR. W. T. GILL, a director of Rolls-Royce, Limited, has been elected president of the Society of British Aircraft Constructors.

MR. W. L. JAMES, a director and general manager of John Lysaght's Scunthorpe Works, Limited, has been appointed a Justice of the Peace for the Parts of Lindsey (Lincs).

MR. A. GRAHAM STEWART, chairman of Stewarts and Lloyds, Limited, has accepted an invitation to sit on the London board of the Broken Hill Proprietary Company, Limited, Melbourne, Australia.

MR. SETH S. SOMERS, chairman of Walter Somers, Limited, forgers, of Halesowen (Worcs), since 1917, is retiring this year. Mr. Somers, who is 79, was made an honorary member of the Iron and Steel Institute in 1947, to mark the completion of 50 years' membership.

MR. L. J. MARKWARDT, an active member of many American technical and professional societies, has been elected president of the American Society for Testing Materials, with which he has been affiliated since 1920. He is assistant director of the U.S. Forest Products Laboratory at Madison 5, Wis. MR. TRUMAN S. FULLER, the new A.S.T.M. vice-president, is engineer in charge of the works laboratory of the General Electric Company at Schenectady 5, New York.

Obituary

MR. ERNEST NOBLE WOOD, a director of Leys' Malleable Castings Company, Limited, Derby, died recently at the age of 79.

MR. JOHN P. M. RODGER, a director of John M. Rodger & Son, Limited, ironfounders, of Townhead, Ayr, died recently. He was 71.

MR. ARTHUR CHARLES KINGTON, Scottish area chief contracts engineer of British Insulated Callender's Cables, Limited, died on June 18.

MR. WILLIAM AGNEW FISHER, late of John Wallace & Sons, Limited, agricultural machinery and engineers' merchants and agents, of Dennistoun, Glasgow, died suddenly on Sunday.

Wills

ALLEN, F. A., a director of Bronze Smelters, Limited, Cardiff £7,140

NICHOLSON, A. E., vice-chairman of Derbyshire Stone, Limited, Matlock £26,375

ALLARDES, WILLIAM, late of A. & J. Inglis, Limited, shipbuilders and engineers, of Glasgow £10,253

GRATTON, D. T., founder of D. T. Gratton & Sons, Limited, agricultural engineers, of Boston (Lincs) £25,875

PLEDGER, C. V., a partner in A. J. Pledger & Company, iron and steel stockholders, of Stamford (Lincs) £22,042

LAW, L. W., late of W. H. Allen, Sons & Company, Limited, mechanical and electrical engineers, of Bedford £7,194

BROWN, A. M., a director and secretary of the Falkirk Brass & Sanitary Engineering Company, Limited £5,381

HARDMAN, R. T., managing director of Robert Hardman & Bros. (Rockcliffe), Limited, ironfounders and engineers, of Bacup (Lancs) ... £6,924

HALL, H. P., of Llanymynech (Montgomeryshire), who was connected with Platt Bros. & Company, Limited, textile and general engineers, of Oldham, for 44 years £138,777

A.S.T.M. Awards

In recognition of outstanding technical Papers presented at its previous annual meetings, the American Society for Testing Materials made awards for three Papers during the 1950 annual meeting in Atlantic City, held in the week commencing June 26.

Prof. B. J. Lazan, of Syracuse University, received the Charles D. Dudley medal for his Paper entitled "Dynamic Creep and Creep-rupture Properties of Temperature-resistant Materials under Tensile-fatigue Loading." The Richard L. Templin award was made to Prof. D. S. Clark and Prof. D. S. Wood, of California Institute of Technology, for their Paper entitled "The Time Delay for the Initiation of Plastic Deformation at Rapidly Applied Constant Stress." Mr. O. B. Ellis, senior research engineer of the Armco Steel Corporation, received the Sam Tour award for his Paper entitled "Effect of Weather on the Initial Corrosion Rate of Sheet Zinc."

The Society has awarded certificates of honorary membership to six of its prominent members "in recognition of their eminence in technical work in engineering materials, and for especially meritorious service to the organisation over many years." They are:—Mr. P. H. Bates, for many years chief of the Clay and Silicate Products Division of the National Bureau of Standards, who was A.S.T.M. president, 1944-5; Mr. W. C. Hanna, chief chemist and chemical engineer of the California Portland Cement Company, and a former member of the A.S.T.M. board of directors; Mr. D. Harvey, now consultant on materials, but for many years electrical and materials engineer with the Westinghouse Electric Corporation, Pittsburgh, Pa., who was president of A.S.T.M., 1943-4; Mr. P. Hubbard, who was for many years chemical engineer with the Asphalt Institute, New York City, and a former member of the A.S.T.M. board of directors; Mr. R. Job, for many years vice-president of Milton Hercey Company, Limited, Testing Laboratories, Montreal, and a member of the A.S.T.M. board of directors, 1914-6; Mr. H. S. Rawdon, who was for 35 years associated with the National Bureau of Standards, becoming chief of the Division of Metallurgy.

Gas Escape at Consett Ironworks

An escape of blast-furnace gas last Saturday week at the works of the Consett Iron Company, Limited, Consett (Co. Durham), resulted in the deaths of 11 men and the removal to hospital of 34 others.

A statement by the company says that the escape occurred about 10 p.m., on a calm evening when the atmosphere was heavy. The gas spread over and hung about a considerable area of the blast-furnace plant. The men were changing shift. As some were overcome by the gas, and the alarm given, men from other departments rushed into the affected area to assist, being in turn overcome until some 45 men were rendered unconscious.

Manganese Ore Dearer

The Ministry of Supply has announced that the certified increase in the price of manganese ore for the manufacture of blast-furnace ferro-manganese is 4d. per unit. The increase came into effect on July 1.

WE REGRET that in listing the newly-elected members of the Institute of British Foundrymen in last week's issue the footnote was omitted. This should have indicated that the members whose names were marked with an asterisk were actually transferred to a higher grade of membership.

Cut down costs in your cupolas by using
STANTON
FOUNDRY PIG IRON
Stanton Machine-cast Pig Irons are clean-melting, and economical in cupola fuel.
All types of castings are covered by the Stanton brands of pig iron, including gas and electric fires, stoves, radiators, baths, pipes, and enamelled products generally ; repetition castings requiring a free-running iron, builders' hardware and other thin castings.
Other grades of Stanton Foundry Pig Iron possess the necessary physical properties and strength ideal for the production of fly-wheels, textile machinery, etc.
Stanton Foundry Pig Iron in all grades is also available in sand cast form.
We welcome enquiries on foundry problems and offer free technical advice.
PROMPT DELIVERY FROM STOCK
THE STANTON IRONWORKS COMPANY LIMITED - NEAR NOTTINGHAM

Pig-iron and Steel Production in Great Britain

Summary of April Statistics

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for May, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in April, with the number of furnaces in blast; Table II, production of steel ingots and castings in April, and Table III, deliveries of finished steel. Table IV summarises activities during the six months ended April.

TABLE I.—*Weekly Average Production of Pig-iron and Ferro-alloys during April.* (*Thousands of Tons.*)

District.	Furnaces in blast 29.4.50	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, Essex	25	—	17.6	23.4	1.1	—	42·2
Lancs. (excl. N.W. Coast) Denbigh, Flints. and Cheshire	5	—	7.3	—	—	0.8	8.1
Yorkshire (incl. Sheffield, excl. N.E. Coast)	14	—	24.1	—	—	—	24.1
Lincolnshire	23	7.4	37.3	0.3	—	1.3	46.3
North-East Coast	8	0.9	10.0	2.3	—	—	13.2
Scotland	8	—	8.9	1.6	—	—	10.5
Staffs., Shrops., Worcs., and Warwick	8	4.6	19.4	—	—	—	24.0
S. Wales and Monmouthshire	7	13.5	—	0.2	—	0.4	14.1
North-West Coast	98	26.4	124.6	27.8	1.1	2.5	182.5†
Total	100	30.1	124.0	28.2	1.2	2.9	186.5*†
March, 1950	100	27.6	119.2	26.8	1.8	3.2	178.6
April, 1949							

* Five weeks. † Incl. 100 tons of direct castings.

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1948.	1949.	1949	1950.	
			April.	March.*	April.
Non-alloy Steel :—					
Heavy rails and sleepers	8.9	9.8	9.0	13.3	11.3
Heavy and medium plates	36.1	39.2	39.1	42.6	41.2
Other heavy prod.	34.7	36.1	34.8	40.3	38.7
Light rolled prod.§	59.7	46.4	44.0	49.2	45.8
Hot-rolled strip		17.1	17.5	19.3	19.3
Cold-rolled strip	4.8	4.9	4.6	5.7	4.7
Bright steel bars	6.1	5.8	5.7	6.3	5.6
Sheets, coated and uncoated	26.3	27.6	25.7	32.4	30.5
Tin-, terne- and blackplate	13.5	13.7	12.9	16.4	13.6
Tubes, pipes and fittings	15.1	18.5	17.8	21.2	19.3
Wire	12.8	15.0	14.1	16.5	14.4
Tyres, wheels, axles	3.9	4.1	3.9	3.5	3.9
Forgings	6.0	6.3	5.9	7.1	6.6
Castings	3.5	3.6	3.5	3.7	3.4
Total	231.4	248.1	238.5	277.5	258.3
Alloy Steel † :—					
Tubes and pipes	0.4	0.6	0.6	0.9	0.9
Bars, plates, sheets, strip and wire	4.7	4.7	4.9	5.0	4.9
Forgings	2.5	2.7	2.5	3.4	2.9
Castings	0.7	0.7	0.6	0.9	0.8
Total	8.3*	8.7	8.6	10.2	9.5
Total deliveries from U.K. prod.‡	239.7	256.8	247.1	287.7	267.8
Add from other U.K. sources	5.7	5.8	5.8	3.9	4.9
Imported finished steel	3.4	7.7	10.8	5.2	4.0
	248.8	270.3	263.7	296.8	276.7
Less intra-industry conversion	35.0	39.1	37.9	44.5	41.2
Total deliveries of finished steel	213.8	231.2	225.8	252.3	235.5

† Excludes high-speed steel. ‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
§ Excl. wire rods and alloy-steel bars, but incl. ferro-concrete bars.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in April.* (*Thousands of Tons.*)

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby., Leics., Notts., Northants and Essex	—	2.4	10.6 (basic)	1.3	0.2	13.9	0.6	14.5
Lancs. (excl. N.W. Coast), Denbigh, Flints., and Cheshire	0.8	22.8	—	1.1	0.4	24.2	0.9	25.1
Yorkshire (excl. N.E. Coast and Sheffield)	—	30.8	—	—	0.1	30.8	0.1	30.9
Lincolnshire	1.7	65.6	—	0.8	0.4	67.0	1.5	68.5
North-East Coast	4.2	43.0	—	1.7	0.7	47.9	1.7	49.6
Scotland	—	14.2	—	0.6	0.6	14.3	1.1	15.4
Staffs., Shrops., Worcs. and Warwick	8.8	53.1	5.5 (basic)	0.8	0.1	68.0	0.3	68.3
S. Wales and Monmouthshire	8.6	26.7	—	7.0	0.6	41.2	1.7	42.9
Sheffield (incl. small quantity in Manchester)	0.1	3.4	4.7 (acid)	—	0.1	8.2	0.1	8.3
North-West Coast								
Total	24.2	262.0	20.8	13.3	3.2	315.5	8.0	323.5
March, 1950*	24.6	264.8	22.0	15.0	3.4	320.8	9.0	329.8
April, 1949	26.2	242.9	18.6	14.0	3.2	297.0	7.9	304.9

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			
						Imports.†	Output of ingots and castings.	Deliveries of finished steel.	Stocks.‡
1938	228	89	—	130	118	16	200	—	—
1948	252	172	200	178	174	8	286	214	1,028
1949	258	169	199	183	188	17	299	231	1,275
1949—November*	249	180	199	187	200	8	315	245	1,246
December	249	170	197	186	181	12	291	231	1,275
1950—January	260	175	198	187	189	11	305	234	1,263
February	250	170	194	184	206	8	325	244	1,257
March*	255	174	197	186	212	12	330	252	1,279
April	242	171	196	183	207	11	324	236	1,320

* Five weeks. † Weekly average of calendar month. ‡ Stocks at end of years and months shown.

MACNAB
MOULDING MACHINES

for High Production

LATEST ENCLOSED SAND PROTECTED JOLT SQUEEZE MOULDING MACHINE

SPECIAL FEATURES:

- MASSIVE YET SYMMETRICAL CONSTRUCTION.
- JOLT RAM—A REAL BLOW.
- SQUEEZES TO A SET PRESSURE.
- PATTERN DRAW—STEADY AND SMOOTH.
- AIR ON OIL CONTROL TO DRAW.
- MECHANISM SAND PROTECTED.
- PATENT AIR-LOADED DISC VALVES.

MORE THAN 400 MACHINES OF THIS TYPE ALONE HAVE BEEN SUPPLIED.

MACNAB Moulding Machines mean CLEAN, ACCURATE AND WELL FINISHED moulds.

We manufacture many other types and sizes of Moulding Machines suitable for economical production of varying classes of work. Catalogues giving full details will be sent on request.

MACNAB and Company Limited

14, ST. JOHN'S ROAD HARROW

(TEMPORARY OFFICES)

Telephone: HARROW 4578

Raw Material Markets

Iron and Steel

Blast-furnace owners have little difficulty nowadays in disposing of any pig-iron which may be surplus to the requirements of their regular customers. Only refined grades are sufficiently plentiful to permit of oversea sales, and the whole of the output of common foundry iron, hematite, and low- and medium-phosphorus grades is passing promptly into consumption. Contrary to the experience of the engineering and jobbing foundries, makers of light castings are working off the orders in hand more rapidly than replacements accrue. Moreover, the holiday season tends to diminish the demand for supplies. But pig-iron stocks are low and replenishment may not be possible until more blast furnaces are at work.

Makers of finished-iron bars are reasonably well employed, but forward commitments are not of such magnitude as to preclude acceptance of further orders with the assurance of prompt delivery.

Rather better news is to hand regarding the position at the re-rolling mills. On a strict comparison, Belgian prices for merchant bars are far below British export prices, but other considerations enter into the determination of oversea contracts, and it is a fact that a few more export orders have been placed with British works. There is still wide scope for improvement, but the outlook has certainly not deteriorated and, if imports of foreign semis are down to a low level, home-produced material is in regular demand.

A steady flow of specifications provides regular employment for the plate mills and full employment throughout the summer months is assured. The lull in the heavy-section trade has also proved of short duration. More orders have been placed for the larger sizes, and these include some acceptable foreign business. Impressive tonnages of rails and other railway equipment are on order and sheet makers are offered far more export business than they are able to accept.

Non-ferrous Metals

The tin market has continued to show strength this week. Last week saw the contango eliminated, and the re-establishment of a backwardation was noted on Tuesday. Modest sales have been reported by the Government and it would seem that consumption in the U.K. is not very heavy. Last week closed with a firm tone in the American tin market, where active stockpiling by the U.S. Government is acting as a spur to buyers.

Metal Exchange official tin quotations were as follow:—

Cash—Thursday, £615 to £615 10s.; Friday, £620 to £620 10s.; Monday, £631 to £631 10s.; Tuesday, £648 5s. to £648 10s.; Wednesday, £659 to £659 10s.

Three Months—Thursday, £615 to £615 10s.; Friday, £620 to £620 10s.; Monday, £631 10s. to £632; Tuesday, £647 10s. to £648; Wednesday, £658 10s. to £659.

The other metals were steady to firm. The fall in lead below 11 cents anticipated a few weeks ago has given place to some prospect of an increase rather than a decline. Zinc was firm at 15 cents on the domestic market, but business for export was reported above that figure. The copper situation was decidedly confused, for with the 2 cents duty in being since July 1 the course of events during the coming weeks was not easy to forecast. Everything points to the tax being temporary, but how the problem will be resolved it is not easy to say. Doubt exists as to the period of suspension which will be eventually agreed, but there can be no doubt that the present situation is crying out for amendment. In the meanwhile it is understood that arrivals of foreign copper in the United States are going into bonded warehouse pending some clarification of the situation. Scrap prices in this country are inclined to ease in face of ample tonnages of brass material put out on tender by the Ministry of Supply.

The usual monthly statistics have been issued by the Bureau of Non-ferrous Metal Statistics and from these it is evident that, so far, inflated values have not told against consumption. For example, in lead U.K. usage in May was 28,271 tons, about 5,000 tons more than in April. Stocks increased from 61,477 tons at April 30 to 65,323 tons at the end of May. In zinc, our reserve tonnage went up from 46,594 tons to 49,841 tons, the increase being mainly in "Prime Western" grades. Consumption was well maintained at 27,241 tons, which compared with 23,802 tons in the previous month. Total copper usage in May was 43,409 tons, comprising 27,709 tons of virgin and 15,700 tons of secondary metal. In April, the corresponding figures were 36,448 tons, 22,884 tons, and 13,564 tons. Stocks at May 31 were 124,290 tons, a drop of some 3,600 tons.

Fourth World Power Conference

Attended by 1,600 delegates from 47 countries, this unique engineering conference was opened last Tuesday by Sir Harold Hartley, F.R.S., who is well known to so many of our readers as a past-president of the British Cast Iron Research Association and the Institute of Vitreous Enamellers. First he read a long message from H.R.H. Princess Elizabeth, who is patron of the conference. As foundry owners throughout the world are insistent in their demands for increased motive power in their works, this conference is of distinct interest. One paper for instance shows the deliveries of coke to foundries from 1939 to 1949. The quantities were in 1939, 900,000 tons, and from 1940 to 1944, inclusive, 1,000,000 tons per annum. In 1945 the amount decreased to 800,000; in 1946 it rose to 1,100,000 and has remained constant at that figure ever since. The interesting fact emerges that coke deliveries bear but little relationship to the output of castings, because the coke is distributed between the iron and non-ferrous foundries. It would appear, however, that the ironfoundries use about 8,800,000 tons a year and the rest 220,000 tons. Superficially it would seem that there are still economies to be made or a reduction if quality were better.

The conference will terminate with a series of tours to the industrial areas and sources of power production. The organisation of such a large manifestation presents many points of interest, not the least of which is the sponsoring and preparation for press of the papers by national committees. This, according to the president, keeps them within reasonable length, as their cost is shared. It is a notion worthy of consideration for smaller functions.

SHEEPBRIDGE STOKES, LIMITED, is the new title for the business formerly carried on by the Sheepbridge Stokes Centrifugal Castings Company, Limited. The company's two factories, at Chesterfield, Derbyshire, and Sutton-in-Ashfield, Notts, will trade under the new name and continue the manufacture of centrifugally cast grey iron, alloy iron and alloy steel under the trade mark "Centricast." The production of sand-moulded castings of alloys of iron and steel will also be maintained, as the change of name involves no alterations either in management or policy.